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HANFORD LABORATORIES OPERATION
MONTHLY ACTIVITIES REPORT
MAY, 1957

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By Authority of CG-PR-2
D. A. Lewis 6/11/92
By B. Clearwater 8/5/92
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Compiled By
Operation Managers

June 15, 1957

CLASSIFICATION REVIEW FOR DECLASSIFICATION PURPOSES UNCLASSIFIED
By [redacted]
Date 5-17-93
U.S. Atomic Energy Commission

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

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TABLE OF CONTENTS

Staff iv

Force Report and Personnel Status Changes v

Promotions and Transfers vi

General Summary . . . . . vii through xv

Reactor and Fuels Research and Development Operation . . A1-1 through A1-21

Reactor Development - 4000 Program . . . . . A2-1 through A2-8

Physics and Instrument Research and Development Operation. B-1 through B-14

Chemical Research and Development Operation . . . . . C-1 through C-31

Biology Operation . . . . . D-1 through D-9

Operations Research and Synthesis Operation . . . . . E-1 through E-7

Radiation Protection Operation . . . . . F-1 through F-10

Laboratory Auxiliaries Operation . . . . . G-1 through G-15

Employee Relations Operation . . . . . H-1 through H-8

Financial Operation . . . . . I-1 through I-5

Invention Report J-1

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TABLE I. HLO-FORCE REPORT AND PERSONNEL STAUTS CHANGES

Date May 31, 1957

FORCE REPORT

	At close of month			At beginning of month			Additions		Separations	
	Exempt	Non-Exempt	Total	Exempt	Non-Exempt	Total	Exempt	Non-Exempt	Exempt	Non-Exempt
Chemical Research and Development	124	94	218	124	92	217	1	2	1	1
Reactor & Fuels Research & Development	137	89	226	139	89	228	0	1	2	1
Physics & Instrument Research & Development	56	24	80	57	25	82	0	0	1	1
Biology Operation	34	41	75	33	42	75	1	0	0	1
Operations Research and Synthesis	12	3	15	12	3	15	0	0	0	0
Radiation Protection	41	195	236	41	198	239	0	1	0	4
Laboratory Auxiliaries	42	189	231	42	195	237	0	3	0	9
Financial	15	31	46	15	31	46	0	2	0	2
Employee Relations	13	13	26	13	13	26	0	0	0	0
General	1	1	2	1	1	2	0	0	0	0
TOTALS	475	680	1155	477	690	1167	2	9	4	19
Totals excluding Internal Transfers	475	680	1155	477	690	1167	2	6	4	16

Composite Separation Rate - - -

TABLE II. PERSONNEL STATUS CHANGES (1)
PROMOTIONS AND TRANSFERS

Date May 31, 1957

Component	PROMOTIONS			EXEMPT TRANSFERS (2)				NON-EXEMPT TRANSFERS	
				To HLO		From HLO			
	Exempt	Non-Exempt to Exempt	Non-Exempt	From Other HAPO	From Other G. E.	To Other HAPO	To Other G. E.	To HLO	From HLO
Chemical	1	0	4	1	0	0	0	0	0
Reactor & Fuels	3	0	6	0	0	0	0	0	0
Physics & Instr.	0	0	0	0	0	0	1(3)	0	0
Biology	0	0	0	0	0	0	0	0	0
Operations Res. & Syn.	0	0	0	0	0	0	0	0	0
Radiation Protection	0	0	0	0	0	0	0	0	0
Laboratory Aux.	0	0	6	0	0	0	0	1	3
Financial	0	0	4	0	0	0	0	1	0
Employee Relations	0	0	0	0	0	0	0	0	0
TOTAL	4	0	20	1	0	0	1	2	3

(1) Data through 5/31/57
(2) Transfers within HLO not included
(3) G. W. Stuart to Vallecitos Atomic Laboratory

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SUMMARY

BUDGETS AND COSTS

In March and April program adjustments were made and cost controls imposed in critical areas to assure that FY 1957 expenditures on the various HLO accounts will not exceed authorized funds. These actions are producing the expected results and, combined with an increase in allocated Plutonium Recycle Program funds, have minimized concern about budget overruns.

Assumptions in regard to other budgets for FY 1958 were revised during the month, notably a decrease in the Special Nuclear Materials research and development program and an increase in the Reactor Development Program. Current total budget assumptions for HLO indicate an average level of personnel of 1167 during FY 1958 which may be compared with 1155 employees as of May 31, 1957.

RESEARCH AND DEVELOPMENT

1. 2000 - Reactor Program

Graphite stored energy data obtained from specimens irradiated at high temperature in the MTR show that the magnitude of stored energy versus exposure at temperatures greater than 600° is small and may be principally removed by annealing at 1000 C.

Hanford test pile measurements on specimens taken from large, 8 x 8" graphite bars purified in the conventional fashion show that the purification process is as effective on these large sections as for standard 4 x 4" pieces. National Carbon specimens of resin impregnated impervious graphite were shown to be sufficiently impure in neutron absorbers to prevent the use of this material in any massive amounts as a moderator.

Six lengths of KER size and eleven lengths of B-D-F size ribless M-257 aluminum process tubes have been received on site and are being inspected.

Previous studies on cavitation flow through process tube orifices provided enough know-how to allow this technique to be exploited as a novel means of flow control on special poison column tubes. Critical flow through the orifice of the tube provides an upper limit on water through-put regardless of the poison column length. This is the first deliberate application of this technique at Hanford.

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Studies of lattice parameters for various IPR fuel elements and lattices, reported last month, has continued this month with additional results being obtained by both experimental and theoretical methods.

Appraisal of a new scheme for the use of Turco to decontaminate rear-face equipment of the reactors based upon short injection periods (5 to 10 minutes) in reverse flow through the resins to the rear-cross-headers and out through the pigtails and rear nozzles indicate only negigible increase in the radioisotope discharge to the river would be expected.

Analytical chemical developments disclosed that Ag-110 present in the recirculating coolant system in KER will interfere seriously with the gamma spectrometric direct determination of Cs-137, Sc-46, Mn-58 and Fe-59.

2. 2000 - Metallurgy Program

One hundred percent canning yield and 100% acceptance on closure inspection has been obtained on 181 cold canned standard dimension fuel elements canned by the point closure technique. These pieces have a thin nickel sweater between the core and the jacket to prevent uranium-aluminum diffusion.

A stainless steel clad, four-rod uranium fuel element has been discharged from the MTR after an exposure of about 550 MWD/T. This is the highest exposure obtained to date on a stainless clad natural uranium fuel element.

Radiometallurgy examination of the HAPO size U-Mg fuel element which exhibited a four volume percent expansion on irradiation in the MTR has not provided an explanation for the volume expansion.

Electron microscope examination of replicas taken from identical areas on uranium before and after MTR burnup of 0.07 a/o has provided information to show that limited microstructural changes result from the irradiation. Narrow twins present in a particular grain widened and coalesced, and there is some evidence to show formation of very small cracks.

The No. 4 loop in the KER facility was charged with standard sized M-388 jacketed slugs with collapsible rails on May 25, and the tube channel is operating satisfactorily with outlet temperatures near 200 C.

A seven-rod cluster fuel element is currently being irradiated in a KE through-hole facility. This test was scheduled for discharge at 600 MWD/T exposure. Approval has now been obtained to continue the exposure to a level of 1000 MWD/T.

A first irradiation of insulated fuel elements in a Hanford reactor has been successfully completed. Three cored insulated fuel elements were irradiated to 617 MWD/T in a KW through-hole. These elements operated in a medium temperature range with uranium surface temperatures of about 280 C and maximum temperatures of about 500 C.

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Flow laboratory tests duplicating temperature and water velocity conditions and including spindles to cause flow disturbances have produced pitting effects on M-388 and 1245 jacketed fuel elements similar to those observed in the downstream portion of reactor process tubes at the H Reactor. This evidence further confirms the opinion that the pitting observed on M-388 jackets after the recent reactor test is a result of flow anomalies and an erosion induced attack rather than a weakness in the corrosion resistance of M-388 alloy.

After two months exposure at 370 C, static laboratory tests continue to confirm the extremely low corrosion rate for aluminum alloy A-203X (5.5 w/o Ni, 0.3 Fe, 0.2 Ti), as reported last month.

3. 2000 - Separations

Physics experiments to determine the maximum safe enrichments of concentrated solutions in the Separations Plants have also continued during the month. An experimental program to furnish information required in the design of a safe dissolver for 0.94% enriched slugs has been developed in consultation with engineering personnel. Exponential experiments to determine nuclear safety limitations for handling enriched I and E slugs have continued.

A near serious incident occurred in the Cold Chemical Semi-Works on May 31 as a result of an excessive reaction rate in the nitric acid dissolution of 0.94 percent U-235 uranium metal scrap. There were no injuries. Principal financial loss is expected to be due to incomplete recovery of the enriched metal. Some operating time will be lost while the building is cleaned of widely distributed uranium oxide particles.

Dissolution rates of dingot metal determined in the Redox plant confirmed laboratory tests on unirradiated samples indicating a 50 percent slower rate than for regular ingot-type metal. A program is being developed to seek means for increasing these dissolution rates.

Studies of rates for mass transfer of uranium from TBP-diluent to an aqueous phase disclose the rate to be first order with respect to uranium concentration in the TBP-diluent system. The rate determining steps is the transfer through the organic boundary film. This is analogous to transfer from aqueous to TBP-diluent phase which appears to be limited by the aqueous boundary film.

The capacity of the Purex 2-A column (a pulsed packed column) is sensitive to the pulse frequency. Semiworks studies indicate a capacity capability of four times design if operated as an unpulsed packed column. Plant tests are recommended to determine the performance with respect to decontamination. The annular-type perforated plate pulsed 2-A column is now ready for operation in the 321 Building semiworks. It has over twice the cross-sectional area of the present cylindrical column and should, if proven operable, satisfy capacity increase objectives.

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Laboratory studies on the behaviour of neptunium in the extraction column of the Purex process have shown that the conditions of acidity, oxidant (nitrate) and time required to establish a distribution coefficient that will allow Np to follow U and Pu are reasonable and should not interfere with decontamination or yield of U and Pu.

Studies of the behaviour of Dowex 1, X-4 (50 to 100 mesh) and Amberlite IRA 401 (20 to 50 mesh) ion exchange resins under simulated process conditions show that the Amberlite has greater capacity and is more resistant to irradiation damage. Scale-up unit studies on the moving bed anion exchange column have disclosed that the expansion of Dowex 1, X-4 in the hydroxide form in water leads to difficulties in moving the resin in the extraction (XA) column. Elimination of the water stream at the top of the column appeared to eliminate the difficulty. Studies on heat loss (the system is specified to operate at 50° C) in the Purex prototype system indicate that except for the downcomer connecting the extraction to the stripping unit, no insulation will be required.

Instances of failures of the 347 stainless steel steam supply lines cast into concrete in the Redox plant appear related to chloride corrosion. The lines were wrapped in corrugated paper and sealed with a plastic tape. Analysis of a sample of the tape gave 19 weight percent chloride. A cooperative program is under way to simulate the corrosion condition found to the end that Radiographic Testing can calibrate an eddy current tester to examine all of the steam lines in the Redox plant.

Investigation of titanium as a material of construction was extended to corrosion behaviour under caustic conditions. At a temperature of 120° C, 30 percent NaOH solution resulted in some pitting with equivalent uniform corrosion rates of greater than 2 mils/month. Jacket removal conditions, i.e., a NaOH - $NaNO_3$ system resulted in rates of less than 1 mil/month.

Plugging problems have developed in the off-gas system from the continuous UNH to UO_3 calciner units. A simple nitric acid scrubber appears to be potentially suitable for removing 97 percent of the entrained oxide.

The Flurex process studies have led to further simplifications of the multiple trench cell design as well as definition of anolyte acidity effects upon cell behaviour and efficiency.

Ammonium fluoride dissolution of zirconium was extended to alloys of uranium and zirconium. Zirconium rich alloys (95 wt percent Zr) dissolved at a rate of 130 mils/hr in boiling 6M NH_4F. The uranium precipitated as a fine black solid identified as NH_4UF_5. Lean alloys (10 percent Zr) dissolved only partially.

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Simulation of the alternate exposure of 304-L stainless steel to NH_4F and HNO_3 as would prevail in dejacketing and dissolution of zirconium-clad fuel elements resulted in corrosion rates as large as 7 mils/month. It is believed that the conditions were more rigorous than would prevail under plant operational conditions.

Waste disposal studies included exploration of a method for sealing a soil structure with calcium silicate by the injection of calcium chloride followed by sodium silicate which has possible application for making waste retention basins.

Gelation studies on synthetic zeolites (sodium alumino silicates) advanced to small scale field type tests wherein a bed of the zeolite was placed between two layers of soil. Absorption of the water by the soil reduced the volume of the gel by one-third.

4. 4000 - Plutonium Recycle Program

The scope preparation for the experimental reactor (PRPR) is estimated to be 60% complete. The Building and Services criteria are finished, and various other criteria packages will be issued soon.

Analysis of data obtained in the Physical Constants Test Reactor on the 7" lattice for the recycle reactor continued and experimental work on the 8" lattice began.

Examination of two tubular uranium dioxide fuel elements irradiated in the MTR confirmed previous observations by showing radiocracking and a tubular crack at the adiabatic radius of the cross section which was 1.44" diameter with a 0.4 inch central hole.

A novel method of etching ceramics has been developed. A wire gauze contacting the cathode of an ion bombardment device is placed on the specimen; sputtering produces a conducting metal film on the ceramic surface and this makes ion bombardment etching possible.

A dummy, full-size, 19-rod PRPR fuel element is operating in a vertical flow loop at 300 C and prototypical flow.

Two aluminum - 1.65 w/o plutonium and two aluminum - 12 w/o silicon - 1.65 w/o plutonium alloy capsules began irradiation testing in the MTR on May 13, 1957. One capsule of each fuel material will be irradiated to 25% burnup of plutonium atoms and one capsule of each fuel material will be irradiated to 50% burnup of the plutonium atoms. A maximum core temperature for these capsules of 340 C was calculated for a specific power generation three times the average specific power generation expected for similar elements operating under PRPR conditions.

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5. 6000 - Biology Program

Radioiodine in thyroids of rodents did not change markedly during the month and showed some increase at certain locations when compared to values obtained one year ago. Fission products in rabbits were about the same as one month ago. Fission products transferred to waterfowl at swamps decreased, presumably due to the shutdown of TBP operations.

River animals generally showed a decrease in contamination during the month, due principally to the spring freshet. Early results show that Cr (III) is considerably less toxic to fish than Cr (VI). Juvenile whitefish appear to be unaffected by a 3 C increase above the average temperature for the Columbia River for exposures as long as one month. For six months, however, mortality is increased.

Long-term results on Cs^{137} buildup in rats indicate that predictions previously based on short-term experiments were correct in support of the present permissible limits.

Radiostrontium in milk deposited on bones of rats to the same extent that radiostrontium in water deposited. Apparently the calcium in milk had no effect on the deposition of strontium. Radiostrontium protein-bound in ewe's milk appears to deposit in rat bones to the same extent that strontium-nitrate in water deposits. Other work on strontium-calcium relationships in animals continued.

The previously reported figure for radioactive particle retention in mice of 12% was changed to 23%, based on more valid information of pulmonary volume.

Injury to the gastrointestinal tract was shown to be more severe following whole-body irradiation than following only gut irradiation, using similar doses.

It was found that from about one-half to one million r seem to serve very nicely to preserve anatomical specimens for future study. This has some advantages over conventional procedures in that original coloration seems to be preserved.

A breakthrough in RBE measurements was made during the month by observing that previous difficulties have been due, in large part, to iron contamination in platinum being used for holding polonium, and not the P^{32} obtained from Oak Ridge.

Important results were obtained in strontium-calcium relationships in plant work. Recent work on the Sunshine Project showed that the radiostrontium-calcium ratio in plants is higher in areas of the earth where the calcium content of soil is lowest. It is being presumed by many that this indicates an increased hazard in these low calcium areas. This carries the assumption that the calcium contents of all plants are similar and are independent of

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the calcium concentration of the soil. Local measurements, however, have just shown that the calcium concentration in plants can be made to vary over a considerable range, and is indeed a function of the concentration of the calcium in the soil. Further work to confirm this important result is in progress.

TECHNICAL AND OTHER SERVICES

One case of plutonium deposition, less than 1% mpl, was confirmed during the month. The total on record to date is 201.

Weekly reading of pencil meters was initiated in the 300 Area.

A final draft of an interim report on the philosophy of measurements in industrial operations has been completed by Operations Research and Synthesis.

Significant progress has been made in an area of mathematical research with important applications to the theory of reactor exposure and to critical mass relationships.

Stack heights on 165-KE Building were specified as the result of atmospheric physics experiments performed at the site. The problem involved only non-radioactive furnace off-gases.

In cooperation with Industrial Medical and Radiation Monitoring Operations, a study was started of the gonad dose of the local population from the diagnostic use of X-rays.

SUPPORTING FUNCTIONS

1. Financial

A significant increase in the average daily variation from travel and living expense of Hanford Laboratories Operation was noted during April compared to prior months. A comparison was made of the trend in such expenditures by HLO during the current fiscal year with other HAPO components. In general, it was noted that most of the other components reflected the same trend. An overall revision to the Hanford Laboratories budget of charges to the fee is being studied to provide new allocations to the Level 3 components for the last half of calendar year 1957.

AEC's decision to change, during FY 1958, the financial control on equipment from an obligational ceiling to a cost ceiling appears to create new problems in equipment funding next year. As many HLO commitments are projects and consequently long-term in nature, the change to a cost ceiling will require funding from FY 1958 funds to the extent costs are actually incurred during FY 1958. This will tend to make less money available for short term commitments (purchase orders). This entire matter is under review by HOO-AEC and Contract Administration with all HAPO financial components participating.

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2. Employee Relations

On May 31 the staff of the Hanford Laboratories Operation totaled 1155, including 475 exempt and 680 non-exempt employees. Of the total exempt employees there were 411 with college degrees, including 395 technical degrees as follows:

BS	MS	PhD
199	101	95

In addition there are 35 non-exempt employees with college degrees.

The AEC Radiological Physics Fellowship Program planning is continuing on schedule and will be completed satisfactorily prior to the commencement of the Program on June 24.

Fifteen suggestions were adopted during the month. A total of $635.00 was granted in awards. Savings represent $5,087.80.

During the month there were 4.3 suggestions submitted per 100 eligible employees.

The Regional Monitors negotiations are continuing as are discussions regarding the Wonacott arbitration case. The outlook for settlement of these two cases remains cloudy.

Three grievances were received during May with one being settled at Step I, one (non-unit) being settled at Step II and the third pending Step II discussions.

On May 22 Hanford Laboratories personnel qualified for their first Safety Council Award as a result of completing 264 days without a disabling injury.

During May Laboratories personnel worked a total of 197,206 hours with no disabling injuries. Since 1/1/56 a total of 1,704,304 hours have been completed without a disabling injury.

There were 28 medical treatment injuries this month with a frequency of 1.42 as compared to 2.02 for the previous month. The frequency for the year to date is 1.73

The explosion in 321 Building on May 31 resulted in damage slightly in excess of $10,000. The three employees who were exposed to oxides of nitrogen gas did not incur serious or continuing injuries and are therefore carried as medical treatment cases. However one employee who was reputedly pushed against the wall by the force of the explosion reported to First Aid several days after the incident and at this time is still receiving treatment at the clinic.

There were three security violations reported during May bringing the total for the year to date to 43.

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F. W. Albaugh

Acting Manager
HANFORD LABORATORIES

FW Albaugh:lt

REACTOR AND FUELS RESEARCH AND DEVELOPMENT OPERATION

TECHNICAL ACTIVITIES

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A. FISSIONABLE MATERIALS - 2000 PROGRAM

1. METALLURGY PROGRAM

Corrosion Studies

Erosion-Corrosion of M-388 Alloy. As was stated in the monthly report for April, the downstream fuel elements (No. 1, 2, and 3) in the four tubes on Production Test IP-43-A-84MT (PT 105-622-A-68MT) had corroded in a non-uniform fashion. Large, deep pits were formed more or less in a line with the direction of flow. One element was transferred to the Radiometallurgy Laboratory and examined in the hot cell. The pits had smooth, sloping walls and sharp intersections just as if the metal had been removed with a sharp gouge.

The appearance of these fuel elements so suggested erosion-corrosion or cavitation-erosion that a laboratory experiment was designed to duplicate this effect. Some fuel elements canned in M-388 and in 1245 alloy were exposed in a B-D-F flow tube in the 314 Building along with spindles to cause flow disturbances. During the test the inlet pressure varied from 120 to 140 psi and the temperature varied from 95 to 97 C. It was estimated that the temperature at the slug surface was 65 to 80 C below the boiling point. These conditions were very similar to those experienced by the downstream fuel element in the production test. After one week, pits similar in appearance to those described above appeared on the test pieces. The maximum penetration was over 25 mils.

It was concluded that the pieces corroded by cavitation-erosion as a result of flow disturbances. The localization of the damage resulted from the pressure and temperature conditions at the downstream end (highest water temperature, lowest pressure, and change in flow pattern). Further tests are now in progress to determine the relative susceptibilities of M-388 and 1245 to this type of attack. Other flow tests are being planned which will characterize this phenomenon more clearly.

Corrosion of A203X Alloy. The new aluminum alloy, A203X (Al, 5.5 wt % Ni, 0.3 Fe, 0.2 Ti) has been exposed to 370 C water for a period of up to two months. The amount of corrosion has been determined by weight loss and by weight gain methods. After a short period of relatively rapid corrosion, the corrosion rate becomes very low ($\sim$0.6 mil/year) and appears to decrease with time. This alloy is the only one tested so far which is resistant to water at this temperature. The corrosion rates of M-388, M-400, and other similar alloys at 370 C are too high for practical applications.

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Effect of Iron Additions to Can Stock. To confirm the effect of iron additions to can stock in laboratory melts on inhibiting intergranular attack in hot water, a series of alloys of increasing iron concentration was obtained from ALCOA. These alloys, based on 1245 can stock specification, varied in iron concentration from 0.21 to 1.5 per cent. To obtain a significant degree of protection at 275 C, at least 0.4 per cent iron is required; at 290 C, approximately 0.5 per cent; and at 350 C, 1 per cent iron.

Somewhat similar results have been obtained with additions of titanium to can stock. A series of melts is being prepared to evaluate the effect quantitatively.

Corrosion of Zirconium in Organic Coolants. Zirconium or its alloys would be valuable materials for process tubes and fuel jackets in an organic cooled reactor due to their low neutron cross-section and high-temperature strength. However, zirconium will react with the hydrogen formed by the thermal and radiolytic breakdown of the organic coolant. The following table shows hydrogen pickup in zirconium specimens exposed to MIPB (monoisopropyl biphenyl) in static reaction chambers. The hydrogen pressure resulted from thermal breakdown of the organic material.

Temp. °C	Time Days	Max. Pressure psig	Hydrogen Content ppm
350	6-1/2	50	40
350	28	50	380
375	6	90	360
400	4	210	770

If hydrogen pressures as high as those listed were encountered, zirconium could not be used as a tube and jacket material in direct contact with the MIPB. However, in an organic-cooled recirculating reactor system provided with a degasifier it should normally be possible to maintain a low partial pressure of hydrogen.

Laboratory test apparatus designed to prevent high hydrogen partial pressures in the bomb used for corrosion testing has been constructed and put into operation. This unit allows the organic liquid to reflux and the hydrogen to be vented at the desired testing temperature.

Radiometallurgical Examinations

Examination of UO_2 I&E GEH-4-D (RM-180). Two I&E slugs of UO_2 (GEH-4-D) were received in April from the MTR. The slugs were canned in zirconium. The first slug, with an exposure of 145 MWD/T of uranium, was visually examined and then sectioned at the midpoint. No defects were observed in the can. The fuel material was cracked but did not appear as fragmented as the material from GEH-3-19. There was no evidence of melting.

Coaxial Fuel Element Examination. The coaxial fuel element (GEH-4-15; RM-175) was sectioned, exposing a one inch longitudinal section on each end, to facilitate length measurements of the components with the fuel

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element intact. The length of the inner cylinder increased nine mils or 0.3 per cent. There was no bonding between the inner and outer cylinder in the exposed portion of the fuel element. Examination is being continued.

Examination of Production Test 105-3N Supplement A (RM-108). Work was continued on the determination of the effects of post-irradiation annealing on the tensile properties of uranium. Three samples with 620 MWD/T exposure were annealed. The first sample was annealed for 10 hours at 800 C and the second was annealed for 10 hours at 700 C. A heating and cooling rate of 10 C/hr was used above 600 C (high alpha region temperature). The yield strengths for both samples were greatly reduced, being comparable to that for unirradiated material. The elongation of the sample annealed at 700 C was 2.1 per cent while the elongation of the 800 C annealed sample was 12.4 per cent. The elongations of unannealed samples of the same exposure were less than one per cent.

The third sample was annealed for three hours at 700 C. A heating rate of 10 C/hr and a cooling rate of 150 C/hr were used. Again, a considerable reduction (from 60,000 to 24,000 psi) was observed in the yield strengths, although not as much as that observed for the sample which was cooled slowly from 700 C. The elongation was 1.1 per cent.

Rare Gas (RM-92). A revised and simplified glass collection train has been constructed and found to be leak-proof. Manual Toepler pump controls have been installed, representing a considerable saving in time and expense, and a more easily operated installation. A leak of 1.2 u/min appears to exist in the drilling unit, although it may be outgassing. This is to be checked by helium leak testing.

Equipment for plastic filling of the irradiated ceramic capsules has been completed and is being tested.

Basic Metallurgy Studies

Optical and Electron Microscopy. The examination of the microstructure of materials by microscopic techniques is a relatively simple and valuable way for detecting the effect of prior treatments. If the prior histories such as fabrication, heat treatment, and perhaps more important, reactor irradiation are understood, a logical approach to improving the material can be made. Specific areas in replicas of uranium irradiated in the MTR to a burnup of 0.07 per cent are being examined in the electron microscope. Direct comparison of identical areas in the replicas corresponding to the pre- and post-irradiation states have revealed limited microstructural changes. It has been established, however, that narrow twins present in a particular grain in the pre-irradiation state have widened and coalesced as a result of the irradiation. Since electron microscopy has revealed a number of very small cracks in a specimen irradiated to a burnup of 0.03 per cent of the atoms, detailed examination of the prior irradiation structure in three irradiated specimens (0.03, 0.07, and 0.10 per cent burnup) is being made.

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Examination of the microstructure of a sintered aluminum powder extrusion, Alcoa APM-276, containing about 16 per cent Al_2O_3 has been completed. This specimen was etched by ion bombardment and shows not only the oxide particles, but also the primary aluminum grain structure. This etch is far superior to the etchants described in the literature.

Additional specimens of porcelain have been etched by ion bombardment to establish the mechanism of etching. A wire gauze contacting the cathode and the specimen is subject to sputtering, and an electrically conducting metallic film forms on the non-conducting surface. The specimen, therefore, becomes a pseudo conductor and etches under the same conditions which apply to conductors. A technical paper describing the universal applicability of ion bombardment as an etchant for cermets and refractories is being prepared as well as a report correlating the particle size and surface characteristics of UO_2 with sinterability.

A twenty-minute, 16 mm color movie film with sound, entitled, "An Adventure in Metallurgy - The Micro-Deformation and Fracture in Uranium," has been prepared for educational and technical showings.

Thermocouple Irradiation. A knowledge of the errors in temperature measurement of thermocouples exposed to a neutron flux is essential if the results of neutron irradiations are to be evaluated quantitatively. Due to a lack of such knowledge, a program of measuring thermocouple stability is currently under way. A two-week, continuous test of the third aluminum-lead thermocouple capsule yielded twelve cooling curves for each of the four thermocouples included in the capsule. Two-week operation of the capsule disclosed no basic faults in the method of temperature maintenance and control. The cooling curve data are being analyzed statistically for deviations in indicated arrest temperatures. Some irregularities in the duration of the thermal arrests were observed. These appeared to be related to the prior thermal history of the capsule, such as its time at a given temperature below or above the arrest prior to cooling. Cooling rate and heating rate also affected this arrest time. The effects were thought to be related to the solidification pattern of the lead about the thermocouple well; consequently, the capsule is now being radiographed to study the distribution of the lead. Further studies of power required to heat the capsule and of the effectiveness of air cooling has led to the conclusion that the total weight of the capsule must be reduced to limit the gamma heating in the reactor. Some new capsule designs are being studied for this purpose. Attempts to fabricate adequate lead wire assemblies from the asbestos insulated thermocouple wire on hand have been rather discouraging. The filler (probably a silicone grease) used in the asbestos introduced a considerable galvanic effect between open ended lead wires. Voltages and current of the order of one volt and 100 microamps have been measured in short lengths of the copper-constantan wire. The high temperatures needed to drive off this product in baking out, result in embrittlement of the iron and chromel wires. The wire would probably function satisfactorily for normal industrial applications, but the inherent uncertainty in its response within a reactor would jeopardize the results of any in-reactor tests. Replacement of this wire by wire with an extra low boron high temperature fiberglass insulation is now being considered.

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Irradiation of Zircaloy-2 Tensile Specimens. Mechanical property data for irradiated specimens of projected structural metals are necessary in establishing material limitations and optimum conditions for reactor service. Annealing studies were completed this month on specimens of Zircaloy-2, exposed in the Materials Testing Reactor to 1.4×10^{20} nvt (> 1 Mev), with the testing of specimens annealed 10 and 100 hours at 375 C. The temperature range for recovery as indicated by yield strength measurement is not appreciably different than that for removal of cold work. The yield point developed in Zircaloy-2 by irradiation was removed during annealing at 300 C, indicating that a more mobile defect or geometrical arrangement of defects is responsible for the yield point generation than for the increase in yield strength.

Recrystallization and Recovery of Zirconium Alloys. The kinetics of recrystallization and recovery in zirconium, Zircaloy-2, and Zircaloy-3 are being determined to establish the optimum conditions of heat treatment during fabrication operations. Per cent cold work, temperature, time, and heat treat atmosphere have been selected as variables. Sample stock of zirconium has been prepared during the month to produce 0.062-inch thick sheet in 10, 25, and 50 per cent cold reduction levels. The material was reduced from 0.250-inch thick plate in a series of rolling and annealing steps, the final step being 20 per cent reduction followed by 600 C, one hour vacuum anneal to produce uniform penultimate grain size for the three conditions. Hardness tests were completed for Zircaloy-3 (vacuum melted ingot) specimens of the three cold work levels, heat treated in air and helium at temperatures of 300, 400, 500, 600, 700, and 800 C for times of 10, 100, and 1000 minutes. These data are essentially the same as those obtained for the argon-melted Zircaloy-3 stock, indicating little effect on the melting history on recovery of mechanical properties. For the 50 per cent cold worked material a minimum hardness was reached in 1000 minutes at 600 C. Annealing at 700 and 800 C resulted in increasing hardness for both air and helium atmospheres indicative of gas contamination. This effect was noted in the 10 and 25 per cent cold worked material also. The increase was greater for longer annealing times, but was not appreciably different in helium than in air.

New Fuel Element Development

KER Size Wafer I&E Fuel Elements. The fabrication of the first twenty KER wafer I&E fuel elements required for loop testing is 75 per cent complete. Fifteen fuel elements have passed existing pre-irradiation tests and are ready for rails and autoclaving. The additional five are scheduled to be canned May 31, 1957, pending increasing the ID of the washers 0.005" which is required to increase the canning yield.

Cold-Press Canning. Fabrication of 181 fuel elements for an in-reactor evaluation of the cold-canning process is complete. These elements utilize a thin nickel sweater between the core and jacket as an U-Al diffusion barrier and have been closed by the point closure technique. An extensive pre-irradiation examination program is being applied currently to the test elements. The canning yield on this test was 100 per cent. Destructive and non-destructive testing has yielded 100 per cent acceptance of the closures on the test pieces.

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Hot-Press Canning. The final approvals have been obtained for PT-IP-45-A, "Preliminary Evaluation of Hot-Press Canned I&E Slugs," HW-49746, 4/22/57. The fuel elements for this test will be taken to 105-C and charged during a June shutdown.

New Canning Developments. A technique has been developed whereby bond strengths of 10,000 psi are obtained on an U-Ni-Al system. This is achieved by drawing aluminum over nickel-plated uranium and then diffusing unrestrained in an oven at low temperature. The technique is being applied to full size fuel elements for further development.

Roto-Arc Welding. Successful closure of unbonded, thin-wall fuel elements has been attained with the Roto-Arc welding unit. Low power and a short time cycle were employed in obtaining the closure. Fabrication of the vacuum chamber for the small diameter Roto-Arc unit has been completed. Completion of the unit is pending the arrival of core material for the coil.

Self-Supported Fuel Elements. Self-supported fuel elements are designed to accurately position the fuel element in a smooth bore process tube. Support designs have been developed for three different services. They are: supports for standard "F" canned fuel elements, supports for 1.8-inch diameter KER fuel elements, and supports for 1.44-inch diameter KER start-up fuel elements. Out-of-reactor testing is complete for all systems and a production test proposal has been written for the standard "F" canned fuel element support design. An evaluation of the performance of this support method under reactor operating conditions is required to complete the test of this system. The two support designs to be used in the first changing of the KER tubes is now approximately 70 per cent completed.

Cluster Fuel Testing. One of the in-reactor pressurized water loops at the KE Reactor KER facility is now scheduled to operate at a bulk outlet temperature of 240 C during July. Stainless steel clad four-rod cluster fuel elements, which were originally designed for 300 C operation, will be used to provide power to the loop. Forty fuel elements have been completed and modified to run in the smooth wall Zircaloy-2 tube provided at KER. These forty elements have passed autoclave leak testing and dimensional inspection, and are now stored at 1706-KE. One, four-rod cluster fuel element has completed three MTR irradiation cycles for a total exposure of about 550 MWD/T. This is the longest exposure yet attained in a stainless steel clad natural uranium KER prototype. Radiometallurgy examination has been requested at the MTR in order to check the effects of irradiation on the fuel dimensions prior to operation of cluster fuel at KER. A Zircaloy-2 clad fuel element of similar geometry will be charged as the next cluster fuel irradiation at the MTR.

Fuel Elements for the KER-1 Organic Loop. It was tentatively proposed that 1.44 to 1.5 OD cored fuel elements be used for the initial loadings of the KER-1 loop. The types of cladding proposed for these runs were Mg - 6 w/o Al - 1 w/o Zn alloy (the only magnesium base tubing available), standard aluminum AlSi bonded, hot press aluminum with nickel diffusion

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bond, and steel. All the magnesium alloys tested show less resistance to deformations at proposed KER-1 loop temperatures than pure magnesium. The alloys containing zinc are particularly weak. Mechanical stability and hydrogen permeation tests to determine the suitability of the magnesium alloy tubing for the KER-1 test elements were initiated.

Thin Wall Stainless Steel Fuel Cladding. Uranium rods of 0.570-inch diameter were clad with 0.007-inch wall stainless steel tubing. This thin walled cladding collapsed into the tube end clearance under the pressure exerted during autoclaving in 300 C water. The end clearance provided was that required to eliminate longitudinal thermal stresses in the cladding during reactor operation. Under constant temperature conditions in the autoclave the end clearance was not taken up by differential thermal expansion and hydrostatic pressure forced the can wall into the gap. Longitudinal wrinkles also occurred in the clad due to the radial clearance. Although the type of damage observed should not have occurred in reactor operation, there is a need for a better end cap design which provides support directly to the uranium core. Experimental end caps bored to receive a portion of the uranium core are being fabricated.

Seven-Rod Cluster Fuel Element Program. As part of a program to develop a fuel element capable of performing satisfactorily at higher operating temperatures, higher specific powers, and higher burnups than present Hanford fuel elements, an irradiation test of three, seven-rod cluster fuel elements is being conducted in a KE through-hole facility. This test was currently scheduled for discharge at 600 MWD/T. However, since more valuable data will be obtained at longer exposures, an extension was obtained to leave the three seven-rod cluster fuel elements in the reactor for a total exposure of 1000 MWD/T.

Coaxial Fuel Element. Coaxial fuel elements are of interest for HAPO reactor application because they offer promise of having the increased split failure resistance of the larger inner diameter cored element without the accompanying reactivity deficiency. A fuel element specimen of this design was irradiated in the MTR for one reactor cycle as a heat transfer experiment. The sample is now being examined in Radiometallurgy in order to determine what temperatures were reached during operation and what dimensional changes may have resulted from irradiation. Previously, it had been found that the external dimensions were essentially unchanged as a result of irradiation. At the end of the month cuts were made so as to permit measurement of the length of the inner tube and examination of the interior of the specimen. No measurements had been made yet, however. It is anticipated that the examination of this sample will permit the design of a specimen for irradiation to high exposure under the desired conditions, i.e., the inner tube as gamma uranium and the outer tube as alpha uranium.

Insulated Fuel Elements. Insulated fuel elements, in which the uranium fuel operates at high surface and central temperatures, may prove resistant to thermal stress failure. Three cored insulated fuel elements have completed an irradiation in KW-3674 through-hole. The through-hole

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test assembly with contained fuel elements was discharged without incident at a calculated exposure of 617 MWD/T. The through-hole assembly will be cut open in the KW basin and the fuel elements will be discharged for cursory examination. After this preliminary examination the elements will be shipped to the B basin where a more detailed examination will be made and one of the elements will be fractured. It is hoped that an indication of the uranium operating temperature may be gained by examining the fractured piece. Following this, shipment will be made to the HAPO Radiometallurgy facility for scheduled post-irradiation evaluation.

Document HW-49769, "Proposal for the Irradiation Testing of Solid Insulated Fuel Elements," has been issued. On the basis of this proposal a production test for authorizing irradiation of solid insulated fuel elements is being prepared. At an anticipated power of 53.5 kw/ft and with 0.001" of insulation (anodized aluminum), a uranium surface temperature of 420 C and a maximum temperature of 850 C will be obtained. If the calculated temperatures prevail, polyphase operation of the uranium fuel will result. Goal exposure will be 600 MWD/T. There appears to be no hazard with the solid insulated fuel element irradiation greater than with the cored insulated fuel element irradiation just completed in KW-3674.

U-Mg Fuel Material. U-Mg fuel material is being studied as a candidate for high exposure use, particularly with an organic coolant. A HAPO size U-Mg fuel element containing 35 v/o enriched uranium in a Mg - 1.5 w/o Si alloy matrix has been examined in the Radiometallurgy facility after irradiation at the MTR. No explanation is apparent for the dimensional growth, amounting to about 4 v/o expansion of the fuel material, that occurred during irradiation. Contact between clad and core was still intimate and there was no evidence of porosity in the fuel material. A similar fuel element has been examined metallographically after baking at 400 C for 100 hours. The matrix material has been altered by the precipitation of some phase, possibly Mg_2Si which has come out of supersaturated solution in the Mg during the 400 C heat treatment. Whether or not such an effect could account for any of the volume expansion of the fuel material during irradiation has not been determined.

Calculations for the Thermal Stresses in Cylindrical Fuel Elements. Numerical calculations for the thermal stresses and strains in cylindrical reactor fuel elements have been completed for solid, cored, internally cooled, and internally and externally cooled fuel elements. These calculations were based on a method of analysis which utilizes the material model for uranium described earlier. In all the cases considered to date, the cooled surfaces remained at 200 C with the maximum temperature obtained after one half hour of a uniform rate of power increase and then held constant for an additional half hour. The solutions are time dependent and consider the effects of stress relaxation.

Organic Coolant Technology Evaluation Task Force. Members of Fuels Development have worked with personnel of HLO, IPD, and FPD during the month on a critical evaluation of the current status of organic coolant technology for IPR application.

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The goal of the task force is to prepare a detailed technical report which summarizes existing pertinent data and points out critical data that are not now in existence.

Thermal Coefficient of Heat Transfer Between Uranium and Can. A thermal contact coefficient measuring apparatus that will be used to determine constants required for predicting the temperature drop across the can-fuel interface of fuel elements is being fabricated in the shop. One of the important factors in the conductance equation is the constriction number which equals the square root of the ratio of solid contact to total area. The area of solid contact is determined by the Meyer hardness. Examination of the Meyer hot hardness data for Mg, Al, and magnesium alloys obtained by Goffard revealed that the Zener-Holloman relation for correlating creep stress with creep rate, time, and temperature also applies to Meyer hardness. When the equipment is available, this correlation will be tested to see if predicted changes in bond conductance with time, temperature, and pressure agree with experimental values.

Indentation Testing. Indentation testing of magnesium and aluminum and selected alloys as a function of time and temperature is being conducted as a measure of their creep characteristics. Data obtained from such tests will be useful in designing fuel element components such as cladding, ribbons, fins, projections, spiders, supports, etc., for use in high temperature coolants. The tests so far indicate the pure magnesium is as good as some Mg alloys and better than other Mg alloys from the hot indentation standpoint in the temperature range of 300-450 C at extended times (100-1000 hours). Commercially pure (2S) aluminum is better than pure Mg by a factor of 3-4 and SAP (sintered aluminum powder) is better than 2S aluminum by a factor of 5-7. These tests are continuing.

Service. Two hemispherical castings of zinc and twelve of aluminum-silicon eutectic alloy were made for Plutonium Metallurgy Operation, using the 306 facilities. The quality of the castings was high with smooth surfaces and an absence of coring.

The sizing of Zircaloy-2 tubing and the sizing and forming of internally multi-ribbed aluminum tubing by swaging is progressing. More work is required to produce a fully satisfactory product.

One hundred and twenty feet of type 302 stainless steel wire has been swaged and then formed to a rectangular cross section with the draw-bench and turk's head. This wire will be used for concentric fuel element spacers.

2. REACTOR PROGRAM

Coolant Systems Development

Single Pass Coolant Development. Examination of discharged M-388 aluminum alloy jacketed fuel elements from the first in-reactor test was completed. The localized attack previously reported was found

on the last slug downstream in each tube (M-388 in each case); a minor amount of local attack was observed on one 1245 slug and two M-388 pieces further upstream. Weight loss data show no appreciable difference in the general corrosion resistance between the two alloys except for a slight indication that M-388 has a lower generalized corrosion rate than 1245 at the higher temperatures. If subsequent tests demonstrate that the localized attack is a result of position in the tube, and not a function of the type of alloy, conversion to M-388 jackets appears feasible.

KER Activities. Three KER water loops were operated in-reactor with dummy fuel charges. Mechanical and electrical difficulties have been encountered in two of the loops. The remaining loop, No. 4, was charged with standard sized M-388 jacketed slugs with collapsible rails on May 25. Subsequent operation, with inlet water temperatures near 150 C and outlet water temperatures near 200 C, have been smooth.

Rupture Simulation Tests. Nine simulated fuel element rupture tests were conducted using standard diameter slugs. Five wafer slugs (3/16-inch wafers) were ruptured in the temperature range 160-280 C; some tube bulging but no splitting occurred; approximately half the flow annulus was blocked. Four massive elements with collapsible rails were rupture tested at temperatures from 200-260 C. In each case complete flow blockage and severe tube damage resulted.

Organic Coolant Technology. Technical aspects of the KER organic coolant conversion program have been summarized in a rough draft report. A maximum tube outlet temperature of 675 F has been established based on filming effects of MIPB at high temperatures. Recent filming data obtained by the Naval Research Laboratory has permitted setting the filming temperature limit with a known factor of safety (approximately 50 F).

Aluminum Corrosion Studies. An out-of-reactor corrosion test was begun in which the several fuel element types to be tested in KER are exposed to pH 4.5, phosphate inhibited water at 300 C. Included in the test are Elephant and Cow slugs, four-rod cluster elements, and standard diameter, self-supported pieces.

Thermal Hydraulics Studies

Single Tube Flow Anomaly Studies. Experimentation was continued to determine the transient responses in a reactor process tube following an imposed hazardous operating condition. Three different types of tests were performed: (1) a power surge was imposed on a process tube operating at normal conditions, (2) flow was instantaneously reduced to a value as small as 20 per cent of normal, and (3) a slight power increase was given to a process tube operating at incipient instability flow conditions. A total of 90 separate runs have been made in the current series of tests. Of these, 50 apply to B-D-F type reactors, 13 apply to K type reactors, and 27 were made to determine specific characteristics of the apparatus.

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Water Boilout Studies. Experimental tests were performed jointly with personnel from Process and Reactor Development Operation, IPD, on the transient behavior of a process tube following 100 per cent flow reduction. A special process tube which allowed a determination of the steam-water fraction at any point in the process tube during the test was used. Results will be used by Process and Reactor Development Operation to determine the necessity of accelerated vertical safety rods at B-D-F and C type reactors.

Hydraulic Studies. Testing was initiated on devices to provide mixing between the annulus and hole flow streams in I&E slugs. Two types of mixing devices have been tested to date. A short perforated slug introduces approximately a 10 per cent increase in the pressure drop of a regular column of I&E slugs, but results in only moderate mixing. A device especially constructed to achieve a high degree of mixing introduced as much as 20 per cent increase in the pressure drop of a regular I&E slug column.

The hydraulic characteristics of B-D-F type I&E slugs have been determined. For the case of normal flow the pressure drop of an I&E column of slugs is about 83 per cent of the pressure drop of a normal charge of solid slugs.

A special "cavitation" orifice for a poison column at DR reactor was sized using the hydraulics apparatus. The size deliberately selected was such that critical flow of approximately 25 gpm would result regardless of poison column length. This prevents poison slug vibration at high flow rates otherwise associated with reduced charge length while assuring sufficient flow for flush discharge with maximum charge length. Use of orifices of this type which exploit critical flow as a novel means of flow control, and as specified by personnel in the Process and Reactor Development Operation of IPD, represents the first application of this technique at Hanford.

Irradiation Test Engineering

Shielding Studies. Neutron dose measurements were made on the top of KE reactor to determine neutron leakage from the VSR channels before the proposed honing of the VSR step plugs. These measurements will be repeated after honing of the step plugs to determine the increase in neutron dose resulting from the VSR step plug modification.

Temperatures measurements were made at the bottom of the DR Test Well to determine the effect of fringe poisoning at DR reactor on the shield temperature. The indicated temperatures averaged 65 C. Shield temperatures prior to fringe poisoning were in the vicinity of 120 C.

Orders have now been placed for most of the components for the neutron spectrometer. A 100-channel analyzer recently made available by Technical Measurements Corporation has been ordered.

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Nonmetallic Materials Development

Exposure of Candidate Organic Coolants. Three sets of three quartz ampoules containing biphenyl, monomethyl biphenyl, and monoisopropyl biphenyl have been exposed in the Snout II test hole at the KE Reactor. Apart from the study of organic compounds, the exposure has served as a test of obtaining different constant exposure temperatures by varying the heat generation (e.g., by gamma heating) within the sample container. The sample containers employed consisted of an aluminum can in which a solid aluminum cylinder was concentrically positioned by means of an alundum rod, thereby leaving an air gap between the central cylinder and the can wall. The central cylinder was also insulated from the end caps by alsimag spacers. By varying the mass of the central cylinder and thus the equilibrium heat generation, different constant temperatures were obtained at a constant reactor power level.

The temperature which was recorded during the eight-hour exposure period suddenly dropped from 260 C to 54 C in one of the sets of samples. The reason for this failure will be investigated when the containers are opened. The remaining two sets attained constant temperatures of 320 ± 4 C and 340 ± 4 C. Equilibrium temperatures calculated for these containers were 380 C and 400 C, respectively. The difference between actual and calculated temperatures is probably a result of over-simplified heat transfer calculations. Because the amount of heat generating material may be easily varied, this method appears to be capable of furnishing constant temperature exposures over a range of 100 to 500 C.

Graphite Burnout Monitoring - PT-IP-25-A. Fifteen virgin CS-ZBF graphite samples charged into bare channel 3461-E in the B Reactor on March 30, 1956, were discharged on May 10, 1957, after an effective exposure period of 243.4 operating days. The average rates of oxidation of these samples as determined by their weight loss are tabulated below as a function of position in the channel. The limits of error listed are the standard deviations from the mean.

Boat No.	Position in Feet From Front Van Stone Flange	Per Cent Weight Loss Per 1000 Operating Days
1	11.0	0.091 ± 0.004
2	20.75	0.900 ± 0.050
3	30.5	0.065 ± 0.008

These burnout rates compare favorably with rates experienced previously. The oxidation rate of the graphite moderator is not excessive under present operating conditions.

High Temperature Irradiation of Graphite - GEH-9. The GEH-9-5 test assembly has been fabricated and will be shipped to the Materials Testing Reactor for insertion in July. This assembly contains four graphite samples which will be irradiated at approximately 750 C for four cycles of three weeks each. Modifications have been made in the design in an effort to obtain a more reliable assembly. Examination of

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the previous assembly, GEH-9-4, showed that the thermocouple and heater insulation was seriously degraded. In the new assembly thermocouple and heater wires in the high neutron flux region are insulated with L-6 grade vitreous alumina.

Graphite Stored Energy. Results of the differential heat of combustion determinations of the stored energy content of graphite samples irradiated in GEH-9-4 have been received from the National Bureau of Standards. Half of each sample was annealed to 104 K-cal/g-atom (3 hours at 1000 C) and also measured for stored energy content. This allowed a measure of the distribution of stored energy above and below 1000 C for each specimen.

These data represent the first determinations of stored energy under these high exposure, high temperature conditions. It may be concluded that the magnitude of stored energy is relatively low (e.g., 8.9 cal/gm for $\sim$ 10,000 MWD/T at $>$ 650 C exposure) and that most of the stored energy is stored above the irradiation temperature but below an activation energy of 100 k-cal/g-atom. Although these preliminary results will be checked in future irradiations, they do not suggest any stored energy problems in that part of the graphite above 500 C in Hanford reactors.

Infrared Spectra of Irradiated Plastics. Infrared spectra of thin films of polyethylene irradiated in air to 10^8 r have shown that oxidation and changes in unsaturation are the main chemical effects. The oxidation results principally in the formation of ketone and aldehyde groups.

Two new plastic materials; Lexan, a General Electric product, and Film 202, a Bayaer (German) product, have been irradiated in air and examined. No changes in their infrared spectra were found after 1×10^8 r. Following 3.27×10^8 r, a strong band from hydroxyl (OH) absorption appeared indicating chain cleavage.

Graphite Purity Measurements. Purity testing of the first series of experimental graphites received from the National Carbon Company has been completed. These graphites represent three innovations in graphite properties: (1) graphite made impervious to liquids and gases by resin impregnation, (2) graphite welded with a special cement, and (3) graphite purified in 8 x 8" cross section. Standard AGOT bars made of current raw materials were included for comparison.

Comparison of these graphites with previous graphites shows:

1. Standard AGOT graphite compares well with earlier CS and KC graphite.
2. Resin impregnation and heat treatment to 900 C of either AGOT or GBF material results in sufficient impurities to prevent their use as massive moderators.
3. Butt joints cemented and heat treated to 250 C and 900 C show slightly greater purity with the higher setting temperature; however, on the basis of only two tests this may not be significant.
4. GBF graphite processed in 8 x 8" cross section is as pure as previous 4 x 4" cross section material.

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Thermocouple Sampling. Three thermocouple hot junctions and several miscellaneous pieces of thermocouple wire were removed from the graphite stringer RS-6 at KE Reactor and are now in the 3730 Building awaiting further examination and testing. Of the three thermocouples, two had failed and one was indicating reasonable temperatures at the time of removal. High radiation levels were encountered, making recovery of the couples more difficult.

The aluminum pull wire installed in the stringer had melted at several points. Insulation on the thermocouple wire was black and charred and flaked off with any mechanical abrasion. Thermal emf's will be checked on the couples and lead wire resistance determined in an effort to find the cause of the failures.

Structural Materials Development

B-D-F Size Zircaloy Process Tubes. Contract DDR-5, with Superior Tube Company, calls for the conversion of 30 Zircaloy-3 billets to 60 B-D-F size reactor process tubes. New tube-reducing tooling for use in work on the contract was ordered the week of April 1, and was scheduled for delivery by May 21. However, the procurement of extrusions for use with the new tooling and a delay in the modification of the tube reducing machine indicate that no additional tube reducing work can be performed on Contract DDR-5 until August.

Contract DDR-6, with Allegheny-Ludlum Steel Corporation, also calls for the conversion of 30 Zircaloy-3 billets to 60 B-D-F size reactor process tubes. As a part of the work on this contract a series of tests was performed at Tube Reducing Corporation to determine the basis for the design of tube reducing tooling. The tests were performed by personnel from Tube Reducing, Allegheny-Ludlum, and HAPO. The analysis of the results confirmed the necessity for tool designs to give equal reductions of area of the tube wall and of the ribs. The desirability for distributing the reduction of area along the entire working length of the tube reducing mandrel was also demonstrated. It was found that the tool designs used did not conform to these criteria.

Steps that are being taken in the application of the test results include revision of the existing mandrel and fabrication of new dies to comply with the known tool design criteria, the development of methods for accurately locating the tooling in the tube reducing machine in the design locations, and the assignment of qualified development personnel to the project at Tube Reducing Corporation.

It is anticipated that the tube reducing of the remaining tube blanks will be performed about June 7 and 8 on a machine of more recent design than the one which has been used to date. The newer machine will facilitate the use of long tube blanks and also provide an improved feed mechanism.

Zirconium Alloy Creep Testing Program. Document HW-50335, entitled "The Status of the Zirconium Alloy Creep Testing Program at Battelle," summarizes the work that has been performed at BMI as a part of their

Hanford assistance program. A proposed program for the 1958 fiscal year is also described. All future creep tests will be of 2000-hour duration since the present data indicate that a reliable secondary creep rate is not established in a 1000-hour test.

The two creep tests on Zircaloy-2 at Hanford were terminated by a power outage after about 1700 hours. Two more Zircaloy-2 test specimens are ready for testing under conditions of 15,000 psi at 550 F and 15,000 psi at 650 F.

Zircaloy-2 Hydrogenation. The effect of controlled amounts of hydrogenation on the physical and mechanical properties of zirconium alloys is being determined in the laboratory. The equipment for this work has been constructed and calibrated, and during the month three Zircaloy-2 samples were hydrogenated to approximately 1000 ppm of hydrogen. Hydrogen balance values, as determined by weight gains during hydrogenation of three samples were 96.2, 100.0, and 98.1 per cent, respectively.

An experimental program has been outlined to establish an annealing schedule which will assure that specimens hydrogenated en masse will be homogeneous within themselves and with respect to each other.

Burst Testing Facility. Specimens which duplicate the KER nozzle-to-process-tube connection design have been fabricated. The strength at operating temperature of this type of connection will be determined by connecting a test assembly to the ELMO-7 loop. The potential explosive hazard of such a test has been considered and adequate safety precautions will be taken. The experimental arrangement will be of temporary nature with the single objective of evaluating the safety factor associated with the KER tube-to-nozzle connection design.

M-257 Aluminum Alloy Process Tubing. The M-257 aluminum ribless process tubing received from Alcoa on May 24 included six lengths of KER size tubing and 11 lengths of B-D-F size tubing. This tubing will be carefully tested and inspected prior to scheduling installation in the Hanford reactors.

B. WEAPONS - 3000 PROGRAM

Research and development in the field of plutonium metallurgy continued in support of the Hanford 234-5 Building Operations and weapons development programs of the University of California Radiation Laboratory (Project Whitney). Details of these activities are reported separately via distribution lists appropriate to weapons development work.

C. CUSTOMER WORK

Corrosion and Coatings Service Work

The interior of a reactor moderator tank for use with the PCTR was treated with a chromate conversion coating. Three annular tanks for this reactor were also treated. The testing of paint coatings for use in 313 Building

was continued. Several hot pressed I&E fuel elements were tested under flow conditions for localized corrosion resulting from a rough area in the inside surface.

Radiometallurgy Service

I&E Slugs (RM-179). Several I&E slugs irradiated under PT 105-615-A (I&E Rupture Test - C Reactor) were selected by Process and Reactor Development Operations personnel for detailed radiometallurgical examination. The first of these slugs was irradiated in tube 0973-C to a slug exposure of 1840 MWD/t at a slug power of 52 kw/ft. The position of this slug in the tube was No. 7 from the downstream end. Visual examination of the outer jacket revealed nothing abnormal. Examination of transverse and longitudinal cross sections of the slug revealed no macro-cracks or other abnormalities in the uranium, and the bond appeared to be in good condition.

Examination of Ruptured Slug from 3659-C (RM-185). The two halves of the diametrically split slug from 3659-C were separated, the exposed uranium was electrolytically cleaned, and photographs were made. From the longitudinal axis of the slug and extending radially outward, the fractured surface in one direction is very smooth and lies in the same plane while in the other direction the exposed uranium is very irregular. This was noted along the entire length of the slug. Along the smooth-fracture side, the can wall was completely separated the entire length of the slug and approximately a one-eighth inch gap was noted. On the opposite side the can wall was partially intact.

Failure of Redox Steam Feed Line (RM-188). Examination of a section of failed stainless steel-steam pipe removed from the concrete shielding in the Redox plant revealed many pits and surface cracks on the outside of the pipe, some of which penetrated the pipe wall. It is tentatively believed (with Chemical Research and Development personnel) that decomposition of a polyvinyl chloride wrapping around the pipe contributed to chloride stress-corrosion cracking of the stainless steel.

Metallography Service

In view of the advantages gained by the use of an anodizing treatment to produce increased contrast and delineate the microstructure of polished zirconium specimens for polarized light examination, an investigation is under way to establish whether some anodizing treatment can produce equally good results on uranium. To date all attempts have shown negative results.

An investigation of the etching properties of the standard electrolytic polishing solution for uranium (phosphoric acid, ethylene glycol and ethanol in the proportions of 5:5:8) has revealed the possibility of using this solution to etch uranium specimens for examination of the microstructure under bright field illumination as well as polarized light. Results to date have been promising and it is believed that a method for bright field etching can be worked out and used advantageously.

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Samples Processed During the Month

Total samples processed: 176

Photographs:

Micrographs	157
Macrographs	121
Total	278

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The following Trips and Visits Reports apply to activities on 2000, 3000, and 4000 Programs. Technical activities on the 4000 Program are reported separately in HW-50339 A2.

L. P. Bupp

Acting Manager, Reactor and Fuels
Research and Development Operation

LP Bupp:kb

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VISITS TO OTHER INSTALLATIONS

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
JM Jefferes ED McClanahan	5/1-3	UCRL, Livermore, Calif.	Discuss metallurgical problems in connection with Project Whitney work	JC Duncan WJ Ramsey	Yes
WP Wallace	5/1-2	Fernald, Cincinnati, Ohio	Attend Metal Working Committee Meeting	--	Yes
JW Riches	5/2	Wolverine Tube Co., Detroit, Mich.	Consultation on zirconium fabrication	R Paul	No
JW Riches & DE Johnson	5/3	New Rochelle Tool Co., New Rochelle, N.Y.	" " "	WC Rudd	"
	5/6	Tube Reducing Corp., Wallington, N.Y.	" " "	RE Rohrabaugh	"
	5/6-7	Allegheny-Ludlum, Watervliet, N.Y.	" " "	RW Stewart	"
	5/10	Chase Brass & Copper, Waterbury, Conn.	" " "	Mr. Blanc	"
JM Batch	5/10	American Society for Eng. Education Convention, Pullman, Wn.	Participate in panel discussion	--	No
RJ Anicetti	5/5-8	Dallas, Texas	American Ceramic Society Meeting	--	No
	5/9-10	Coors Porcelain Co., Golden, Colo.	Discuss ceramic fabrication processes	WH Johnson	No
JJ Cadwell	5/16-17	AEC-IOO, Phillips Pet. Co., Idaho Falls, Ida.	Consult re policy, methods, & eng. details involved in construction of high pressure loops to be installed in the ETR	Mr. Phillipson A Richardson RJ Nertney	Yes

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1103121

VISITS TO OTHER INSTALLATIONS (Cont)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
WP Wallace	5/21-22	ASM, Chicago, Ill.	Attend meeting-nomination of national officers	--	No
	5/23-24	ANL, Lemont, Ill.	Discuss fabrication equipment & facilities	JF Schumar	Yes
WB Weihermiller	5/21	Vans Metal Spinning Co., Seattle, Wn.	Discuss fabrication of spinning floats	Frank DeBoer	No
		Quality Metal Spinning Seattle, Wn.	" "	G. Vincent	No
PR McMurray	5/27-29	ANL, Lemont, Ill.	Reactor design, construction & operation, and other features of design and reactor technology	DJ Casey	Yes

VISITS TO HANFORD WORKS

Name	Dates of Visit	Company Represented and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
WJ Ramsey OL Meadors	5/6	UCRL, Livermore, Calif.	Discuss design of Pu Lab facilities	OJ Wick ID Thomas MD Freshley	Yes	200W, 231
J Dolio WI Morita	5/6	Shaw-Metz & Dolio Co., Chicago, Ill.	" "	"	Yes	200W, 231
JC Duncan	5/16	UCRL, Livermore, Calif.	Discuss Project Whitney fabrication problems	OJ Wick ID Thomas	Yes	200W, 231
J Whealdon	5/9	Air Supply Co., Seattle, Wn.	Eng. discussions on nonmetallic materials	R Harrington	No	300, 326
H Gillette	5/9	Precision Rubber Products Co., Dayton, Ohio	" "	R Harrington	No	300, 326

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VISITS TO HANFORD WORKS (Cont)

Name	Dates of Visit	Company Represented and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
JC Woodhouse DE Babcock H Worthington	5/13	E.I. du Pont de Nemours, Wilmington, Del.	Discuss duPont power reactor program	LP Bupp JJ Cadwell LH McEwen RM Fryar FW Woodfield	Access permit	300, 328
JL Michaelson	5/22	GEL, Schenectady	Review GEL activities of interest to HAPO	LP Bupp JJ Cadwell KG Toyoda	Yes	300, 328
N Stetson	5/22	AEC-Savannah River Operations Office	Discuss high pressure heat transfer facility	JM Batch	Yes	100D, 189
R Rowe	5/23	General Machinery Co., Spokane, Wn.	Discuss pump problems for PRPR	JO Ludlow	Access permit	700, 713
JW Webster EJ Leshan	5/20	American Standard, AEC Redwood City. Calif.	Discuss PRPR	JR Triplett ED Clayton RE Heineman	Access permits	700, 713 300, 326, 305B
A Bunke	5/27-29	Byron-Jackson Pump, Inc. Los Angeles, Calif.	Discuss pump problems for PRPR	LC Koke JO Ludlow RM Fryar H Harty	Access permit	700, 713 761
FJ Leitz R Stanford	5/16	Atomic Power Development Associates, Detroit, Mich.	Discuss PRPR as related to fast breeder program	RM Fryar	Access permits	700, 713
AR Kaufman	5/27	Nuclear Metals, Inc., Cambridge, Mass.	Fuel element discussions	JJ Cadwell WP Wallace JE Minor GT Geering SH Bush	Yes	300, 326, 303

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1103723

VISITS TO HANFORD WORKS (Cont)

Name	Dates of Visit	Company Represented and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
BR Hayward CG Hoffman JE Mahlmeister LE Wilkinson	5/27-28	Atomics International N.A.A., Los Angeles,	Fuel element discussions	JJ Cadwell WP Wallace JE Minor GT Geering SH Bush	Yes	300, 326 303
HP Berner	5/28	Star Machinery Co., Seattle, Wn.	Confer re extrusion press	WP Wallace DC Kaulitz	No	700
JB Sutton W Larson	5/28	Sutton Mfg. Co., Pittsburgh, Pa.	Same as above	Same as above	No	700

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HW-50339 DEL

1103724

TECHNICAL ACTIVITIES

REACTOR DEVELOPMENT - 4000 PROGRAM

REACTOR & FUELS RESEARCH & DEVELOPMENT

PLUTONIUM RECYCLE PROGRAM

Plutonium Fuels

Capsule Irradiation. An important part of the Plutonium Recycle Program is the investigation, testing, and evaluation of potential plutonium-bearing fuel materials. Two fuel materials, Al - 1.65 w/o Pu alloy and Al - 12 w/o Si - 1.65 w/o Pu alloy, were selected for immediate irradiation testing in the MTR. The former material is of special interest since it is the fuel material planned for initial PRP reactor operation. The latter material appears attractive as a fuel and is being investigated because it has been reported that the silicon addition enhances the corrosion resistance of this material to high temperature water.

Two capsules of each fuel material are being irradiated to 25 and 50 per cent burnup of the plutonium atoms. Eleven fuel material cores were case for the fabrication of the capsules. These cores were cast as 6" rods and the castings were radiographically perfect. Best casting results were obtained with the Al-Si-Pu alloys with melt and mold temperatures of 815 and 250 C, respectively. The Al-Pu alloy was cast with a melt and mold temperature of 850 and 250 C, respectively. It was noted that the Al-Si-Pu rods were more difficult to saw by hand than were the Al-Pu rods; however, the Pu did not have noticeable detrimental effects on the Al-Si base material.

These rods were machined to a 0.501" OD and a 2.00" length. The capsule jackets were machined from Zircaloy-2 bar stock. There was no bond between the fuel material and its jacket and there was a 3-mil room temperature gap between the two. There will be intimate surface-to-surface contact under operating conditions. A 12-mil space between the fuel material and the cap was provided for the differential thermal expansion of the two materials. The calculated core temperature for a specific power generation, three times that which is expected in the PRPR, is 340 C in the MTR and a coolant temperature of 40 C. Two capsules of each fuel material were assembled, welded, and autoclaved for 100 hours in 100 psi steam and shipped to the MTR. The completed capsules were 2.53" long and had an OD over the jacket of 0.565". These capsules were charged in the reactor in Cycle 87 on May 13, 1957, as scheduled. One capsule of each fuel material will be irradiated for one reactor cycle and one of each material for two reactor cycles which is 25 and 50 per cent burnup of the Pu atoms, respectively. Upon completion of irradiation, the capsules will be returned to HAPO for radiometallurgical examination and the irradiated material will then be turned over to Chemical Research for separation studies.

1103725

Three metallographic samples of the Al - 1.65 w/o Pu alloy were prepared and examined. It was observed that the second phase which appears to be of eutectic composition uniformly outlines the primary Al grain boundaries throughout the rod.

Corrosion Tests. Defected zirconium-clad capsules containing aluminum alloys, using uranium as a standin material for plutonium are being corrosion tested by Corrosion and Coatings personnel.

An Al - 0.5 w/o Fe - 1.0 w/o Ni-- 1.5 w/o U-238 alloy core was canned in Zircaloy and defected with a 1/16" diameter hole. This sample was autoclaved at 350 C for 24 hours. While the sample apparently did not swell radially, it did lengthen enough to crack the can at the base of one weld. A similar test of an Al - 12 w/o Si--1.5 w/o U-238 alloy will be conducted as soon as some of this material becomes available.

Formability Studies. Alloys are being fabricated for formability studies of Al-Si-U alloys. Design and assembly of the 125-ton extrusion press is continuing. Fabrication of the hydraulic pumping unit is about one-fourth complete and preliminary tool design is finished.

PCTR Tests. The PRPR fuel elements fabricated for PCTR lattice testing which contained Al - 1.65 w/o Pu alloy cores were returned for some end cap modifications. Following the tests for the 7" lattice, the fuel element "spiders" or holders were altered. This change necessitated end cap contour modifications on 12 fuel elements. These modifications were made and the fuel elements returned to the PCTR for use in the 8" lattice tests which are to commence shortly. Some of the oxide preparation equipment has been received.

Pu-U Mixed Oxide. Mixed crystal oxides of Pu and U have been received from the Research and Engineering Operation of CPD.. The mixed crystals (140 grams) were prepared from a nitrate solution of Pu and U with a Pu-to-U ratio of one to five. It is planned to achieve the desired Pu composition, about 1 w/o Pu, by diluting the one to five mixture with pure UO_2. Preliminary x-ray analysis of this material indicated that it is a solid solution of PuO_2-UO_2. Due to the lack of a hydrogen sintering furnace, it will be attempted to vacuum sinter the oxides in the NRC vacuum furnace. It is not yet known if this method of sintering will be satisfactory.

UO_2 Fuel Development

Nested Tubular Fuel Elements. PCTR tests of nested tubular fuel elements to determine lattice dimensions for the PRPR require 21 feet of UO_2 fuel elements. The fuel elements are being fabricated from UO_2 powder by cold-forming, followed by sintering and grinding to final dimensions. Forming of the central rod was completed by an extrusion process. The inner tube was formed by compaction in a die. The outer tube, having a large cross-sectional area, requires a very large force for forming by compaction in a die; therefore, these large shapes were pre-formed in a die at low pressures and then isostatically pressed to obtain the necessary green density. The per cent completion of each element of the fuel assemblies.

Element	Forming	Sintering	Grinding
Central Rod	100	100	100
Inner Tube	100	10	5
Outer Tube	100	20	15

Zircaloy Clad, UO_2 I&E Fuel Elements. PRPR fuel elements consisting of an assembly of concentric tubes of UO_2 are expected to offer higher uranium density and better utilization of coolant than are the more conventional rod bundles. As part of the irradiation testing program in support of the PRP, two tubular ceramic fuel elements (1.440" OD x 0.400" ID x 4.44" long) consisting of 92 per cent dense UO_2 clad in 0.040" thick Zircaloy were irradiated without unusual incident in the MTR GEH-4 facility. Recent sectioning and examination of the core reveals the expected radial cracking of the UO_2 and a tubular crack which developed at approximately the adiabatic radius. The two elements generated a maximum heat output of 53 kw/ft and a maximum core temperature (calculated) of 1123 C.

M-388 Clad, UO_2 I&E Fuel Elements. Use of UO_2 cladding materials less expensive than Zircaloy would greatly decrease fuel element manufacture costs. M-388 Ni-Al alloy offers another advantage of lower UO_2 core temperatures, because of the relative high thermal conductivity of the alloy. As part of a program of evaluation of cladding materials for ceramic fuels, two UO_2 I&E slugs (1.474" OD x 0.375" ID x 8.850" long), clad in M-388 Ni-Al alloy were inserted into the GEH-4 facility of the MTR for irradiation. Fission product gases were detected in the loop during reactor start-up, indicating a defect in one of the elements. The test elements were discharged and are being returned to HAPO for determination of the cause of leakage.

UO_2 Powder Characteristics and Fabrication Behavior. Correlation of physical characteristics of raw UO_2 powders with fabrication behavior is expected to provide information contributing to improved, more economical production techniques for high density UO_2. The individual and combined effects of ball milling, and controlled temperature oxidation-reduction cycles on raw powders, and of compacting pressures as reflected in sintered densities were investigated using MCW PWR grade (AEC) UO_2, MCW ceramic grade (commercial) UO_2, and UO_2 from HAPO continuous calciner process UO_2. UO_2 from all three sources sintered to 91-92 per cent of theoretical density after one controlled oxidation-reduction cycle, an improvement of as much as 14 percent. PWR grade UO_2 ball milled (dry) 64 hours sintered to 97 per cent of theoretical when pressed at 15 or 35 tsi. The best available ceramic grade UO_2, without ball milling, sintered to 91 per cent of theoretical when pressed at 25 tsi. Increased pressure caused severe cracking on sintering. Improvements in sintered density of PWR and ceramic grades are not strictly comparable due to variation in surface areas of raw powders. Effect of long milling time on impurity content in the UO_2 is now being investigated.

Mechanical Equipment Development

Excavation of the Process Tube Test Shaft was completed during the month. The shaft liner is now in place and the concrete plug in the bottom of the shaft was poured. The ladders, platforms, and equipment remain to be installed.

1103727

Design of the Single Tube Prototype Facility continued. Purchase orders were placed for valves and heat exchangers.

Scoping was begun to determine the necessary changes to the Single Tube Prototype Facility to permit the testing of a full size PRPR pump.

Special test sections to test the various process tube connections and seals were designed and fabrication initiated. Fabrication of the inlet process tube connection test assembly was completed. Fabrication was begun on test sections to test the proposed outlet nozzle caps and the nozzle-to-process tube connection. Detailed scoping of the full size calandria test for moderator flow, moderator level, and dumping characteristics was initiated. Preliminary scoping of the charge-discharge tests and the shim control tests was started. Fabrication of equipment for the shim control tests and a full scale working model of the fuel element discharge hook got under way.

Coolant Systems Development

Operation of the PRPR vertical test section was begun following several weeks of shakedown testing. In this test localized corrosion effects of a 19-rod cluster fuel element at 300 C are under study. Installation of a glass tube of PRPR geometry was begun to enable observations of chattering and flow distribution characteristics.

Thermal Hydraulic Studies

Heat transfer and hydraulic studies in support of PRPR design scoping continued. Construction of the vertical test section facility proceeded at a satisfactory rate.

Shielding Engineering

Analysis has been completed on portions of PRPR shielding requiring further study as a result of recent design changes. More accurate calculations were made to allow maximum cost reduction commensurate with required radiation levels. Studies included the required thicknesses of walls between cells, floor over cells and reactor, discharge chute, discharge cask, and the primary shield.

In anticipation of problems to be encountered in removing the core, decay curves for various aluminum alloys and concretes were plotted. These will allow calculation of expected radiation levels once the geometries and methods of core removal are specified.

Plutonium Fuel Cycle Analyses

Self-Shielded Pu. Further investigations were made of the plutonium self-shielded fuel elements. This fuel element concept makes use of the high thermal absorption cross section of plutonium to limit the fissioning of a plutonium rod to the exposed rod surface. On this basis extremely long in-reactor residence times are possible for a given change in reactivity. This feature reduces jacketing and fuel preparation costs of plutonium

fueled reactors in general and in addition may be of extreme importance to portable power plants such as those employed for submarines and remote areas. The major items to reconcile in the design of a self-shielded fuel element are the heat transfer rate, inventory charges, and permissible reactivity change. As initially visualized, the heat transfer may be a serious problem. This has not been confirmed by analysis to date; for example, a single plutonium rod 0.246 inch in diameter will operate in a D_2O moderated and cooled reactor at 24.5 kw/ft with a 2×10^{13} neutron/cm^2 flux in the reaction zone. A cluster of 19 such rods would generate 166 MWD of heat per foot before showing a reactivity change of 50%.

Uranium-235 can also be used as a self-shielded fuel element and should have merit although the thermal absorption cross section is not as great as for plutonium. This is essentially balanced out by a more favorable ratio of fission to radiative capture.

Experimental Reactor Design

Core Components. The design of the moderator circulation system was improved during the month by the addition of a top drain system which will remove about three-fourths of the total outflow whenever the moderator is at its full power height. In contrast to the old drain system which removed all of the outflow at the bottom of the vessel, this circulation system coincides more nearly with the natural convection circulation path. Along with this change the moderator inlet system was changed to a single inlet pipe feeding into a flat plenum extending completely across the bottom of the calandria. A system of twelve calandria access holes was added to the design.

To eliminate the need for a separate surge tank in the reflector cooling loop, the reflector drain system was modified to permit the reflector tank to act as a surge tank.

Process Tube and Fuel Assemblies. Design criteria have been prepared for the process tube assembly, reactor piping, and fuel assembly. These are currently being reviewed prior to issuing for comment. Revised scope drawings for these items have been completed and are ready for cost estimating. A report, "Design Basis for PRPR Process Tubes," HW-50337, was completed and will be issued as a formal report.

For the preliminary hazards report, a discussion was prepared of emergency procedures and effects on the reactor in event of leaks or failure in the reactor piping.

Helium System. A revised helium system engineering flow diagram and a drawing of the high pressure storage tanks were prepared during the month.

Process Piping and Equipment. The D_2O Piping System Flow Diagram SK-1-6375 was revised to reflect the changes resulting from combining the moderator and primary purification systems and elimination of the reflector treatment heat exchanger. All component flow diagrams and other scope drawings were revised to reflect these changes.

1103729

The criteria for the D_2O demineralization system and the moderator and reflector coolant circuits were issued in rough draft form. Work is continuing on the primary and secondary coolant circuit criteria.

Consultations were held with A. Bunke of Byron-Jackson Pump Company and R. D. Rowe of the General Machinery Company concerning all pumps within the systems.

Data concerning the inventory, pressure, and temperature of light and heavy water were prepared for the PRPR Hazards Report.

Charge-Discharge. A new design for the underwater transfer conveyor has been scoped and included in the criteria document for charge-discharge equipment. The new design provides a more direct transfer system.

Control and Safety Systems. Descriptions and safety analyses of the control and safety systems are under preparation for the hazards report.

A scope estimate for fabrication of the shim control units is being prepared by the Western Gear Corporation. A proposal to furnish a complete shim control drive assembly is under preparation by Globe Industries, Inc. Estimates from both firms are expected in the first part of June.

Commercial soft-seated butterfly valves appear to be attractive candidates for use as dump valves. Special operators would be required to meet required specifications for opening time and for fail-safe operation.

Instrumentation. The Reactor Thermocouple and Miscellaneous Flow System Design Criteria (HW-48101-L) was revised to include coolant flow measurements and inlet and outlet coolant flow temperatures of the shields and reflector. The Criteria Drawing was also revised to include the additional measurements. Both were issued for comment during the month.

The Reactor Safety Circuit Design Criteria (HW-48101-I) was revised and issued for comment during the month. Significant changes included the use of a "two out of three" high neutron level scram, and the elimination of the "power failure" scram contact.

The Ventilation System Design Criteria (HW-48101-O) was issued for comments during the month. Drawing SK-1-6195, Ventilation Control System Engineering Flow Diagram is now in the check print stage and will be issued for comments this month.

A preliminary "work sheet" type of drawing is being prepared showing the control room panel layout. Panel position and approximate instrument locations are being shown.

A table showing the estimated number of wire and tubing runs for each system of instrumentation was issued.

1103730

Shielding. The shielding criteria were prepared in rough draft form. The final comment issue should be ready for distribution the first part of June. Seven shielding drawings are in the process of completion and should be ready for final comment during June.

The cooling system for the thermal and biological shields has been specified. This system utilizes cool water from the 300 Area sanitary water supply. Zeolite treated water (140 F) from the heat exchangers will be used to cool the top and bottom shields. Piping in the thermal shield loop will be stainless steel; the rest of the piping in the shield cooling system will be carbon steel.

Process and Service Area Ventilation. A chilled water system for cooling the process area has been scoped for the containment vessel. This system will replace the previously mentioned self-contained air conditioners. The system consists of a central refrigeration type water chiller located in the service area basement, and air recirculation units located in the containment vessel. Chilled water will be piped to cooling coils in the recirculation units.

Electrical System. A plan was developed for electrical outside lines in the PRPR area to be included in the site and utilities criteria. Designs for cable entrances to the containment vessel have been detailed. The one line electrical diagram was maintained current.

Reactor Building. The final draft of the PRP Reactor Building and Services criteria (HW-48099) was circulated for approval.

Reactor Physics

Reactor Codes. VAL-PROD flux distributions for lattice cells and complete reactor cores, both for K Reactor and the PRPR were obtained during the month. Currently, Chebyshev iteration is being utilized to accelerate the rate of convergence and reduce machine time required.

Fuel Cycles. Formulation of the material balance equations for equilibrium spike enriched plutonium systems has been completed. All plutonium isotopes as well as fission products have been taken into account.

A P-3 calculation on a 19-rod PRPR fuel element containing uniform equilibrium plutonium has been performed to provide a value for the thermal utilization for use in uniformly enriched material balance studies. The value obtained was $f = 0.928$, not significantly different from the value for a spike enriched cell.

The equilibrium cycle calculation program is complete and results are currently being analyzed. A complete report is in preparation.

Reactor Kinetics. The fuel temperature coefficient study on the Goodyear analog computer has been reprogramed to make use of a logarithmetic transformation and hence allow a wider range of reactor powers to be investigated for ramp or step reactivity input. This is now complete except for scaling.

1103731

Hazards Analyses

Containment Building. A two-phase method of constructing the PRPR containment building is being considered. After the steel shell has been erected to grade the interior, construction would be completed before the above-grade portion of the steel shell is erected. This method appears to offer a lower construction cost than the alternate construction method of erecting and pressure testing the steel shell before starting any interior construction. Analyses of possible hazardous conditions which might be introduced by the method are being performed.

Safeguards Analyses and Report. Assignments have been made for writing draft sections of the Preliminary Safeguards Report. The rough draft is about 30 per cent completed. Editing and review of the report will be completed during June to permit publication about July 1.

Zirconium Alloy Tubing

Chase Brass and Copper Company successfully extruded three Zircaloy-2 billets to provide draw bench stock for the fabrication of PRPR size process tubes. The extrusions were of excellent quality. A fourth billet, which failed to extrude, will be re-canned and extruded at an early date.

Thirteen 10-foot lengths of 0.998" OD by 0.030" wall Zircaloy-3 jacket tubing were received from Wolverine Tube Company. The tubing has been shipped to Radiographic Testing Operation facility for inspection.

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PHYSICS AND INSTRUMENT RESEARCH AND DEVELOPMENT OPERATION

MONTHLY REPORT

MAY 1957

FISSIONABLE MATERIALS - 2000 PROGRAM

METALLURGY

Buckling Measurements on Enriched Uranium, Water Lattices

Additional exponential measurements have been completed in the water moderated lattices using hollow fuel elements enriched to 1.466% by weight U-235. These fuel elements are 1.394" O.D., 0.464" I.D., and 8" long. The purpose of the measurements is to determine how the experimental value of buckling depends on the number of tubes in the assembly at various rod separations. For nuclear safety reasons, as the enrichment is increased the number of rods in the exponential assembly must be decreased in order to insure against inadvertently obtaining a critical assembly.

The results of the measurements made during May are listed in the table below.

Separation Between Rods (inches)	H_2O/U* (by volume)	Reflector** Savings (cms)	Number of Rods in Lattice	Buckling (10^{-6} cm^{-2})
2.6	3.15	6.67	31	4306
2.4	2.51	6.86	43	5666
2.4	2.51	6.86	49	5590
2.4	2.51	6.86	55	5828

* With water in core.
**Estimated from Brookhaven data.

The results of the measurements, to date, indicate that an empirical correction of 150 ± 50 microbucks is necessary to make the 31-tube loadings agree with the 55-tube loadings. Although this difference can be relegated to a 0.2 to 0.5 cm uncertainty in the reflector savings, as demonstrated in the previous monthly report, it is also possible that this difference is due to inadequacies of the equivalent cylinder approximation. The absolute value of the 55-tube loading is, in itself, in error from these causes by perhaps 200 microbucks; therefore, it appears feasible to measure the bucklings of fuel elements of 1.6% enrichment using only 31 tubes without seriously detracting from the accuracy of the results. In any event, the estimate of the minimum critical mass should be in error by only 5 to 10%.

Instrumentation

The initial assembly of the experimental slit-camera indicated the need for altering some of the parts.

1103733 DECLASSIFIED [redacted]

A simple viewer employing two mirrors was designed and fabricated for the Plutonium Metallurgy Operation. When used with a lamp and a photometer, this viewer will permit the qualitative measurement of the thickness of corrosion films on product material. The problem of determining the thickness of an oxide film on a metal may be solved through measurements of the elliptical polarization of light being reflected by the metal and the film.

REACTOR

STUDIES RELATED TO PRESENT PRODUCTION PILES

Variation of Graphite Diffusion Length with Temperature

Diffusion length measurements were taken in the large, 101-inch, graphite cube which had previously been heated to 600° C. The pile was at room temperature and measurements were taken with and without the insulation on the pile, and in one case with the thermocouples and heating elements removed. The measured diffusion lengths were in agreement with the results obtained prior to heating the graphite. Removal of the thermocouples and heating elements increased the measured diffusion length by about 0.6 cm.

Upon removal of the magnesia block insulation it was noted that some damage had occurred by oxidation to the outer surface of some of the graphite bars. Spectrographic analysis of samples from several of these bars indicated impurities (principally iron) to be present. It is believed that metallic impurities act as a catalyst to speed up the graphite oxidation process at elevated temperatures.

Neutron Cross-Section Studies

Pu-240 Total Cross Section - The past month has been used to continue the data on the 1 ev resonance in the total cross section of Pu-240. Sufficient data have now been accumulated so that the expected statistical errors approach the capabilities of the instrument. A large fraction, but not all, of the data have been calculated. A resolution correction was calculated and applied to the data and found to have a negligible correction in the observed half width of the resonance. The doppler correction has also been examined in some detail and found to be valid. The present results, although still not final, agree quite well with our preliminary analysis which yielded a much smaller resonance width than is generally accepted for this resonance. Our present results are:

$$E_o = 1.056 \pm 0.001 \text{ ev}$$

$$\Gamma\Delta = 52.2 \pm 2 \text{ mv (observed width - resolution corrected)}$$

$$\Gamma = 28.5 \pm 3 \text{ mv (doppler corrected)}$$

Single Crystal Growth - We have attempted to grow single crystals of both lead and aluminum suitable for use as neutron monochromators with the crystal spectrometer. A 3-inch diameter Al ingot was grown which consists of apparently no more than 4 large grains. One of two Pb crystals shows promise of being a

single crystal. These crystals will be tested by neutron diffraction studies to determine if either will be suitable as a monochromator.

Effect of Nitrogen on Diffusion Length Measurements

The effect of nitrogen on pile start-up diffusion length measurements is being studied. Consideration is given both to N_2 in moderator holes and channels and to N_2 trapped in graphite.

STUDIES RELATED TO FUTURE PRODUCTION PILES

Some Calculated Lattice Parameters for Organic Cooled, Graphite Moderated Reactors

In connection with the program for evaluating the potentialities of organic-cooled, graphite-moderated reactors, the thermal utilizations of two lattices were calculated as a function of the process tube material and thickness. The two lattices are described by the following geometrical properties.

	Case I	Case II
Enrichment	natural	1.5% by weight U-235
Slug Diameter	1.93"	1.93"
Aluminum Jacket Thickness	0.010"	0.010"
MIPB Coolant Annulus Thickness	0.100"	0.100"
Carbon to Uranium Atomic Ratio	50	29
Lattice Spacing	9.3"	7.2"

Some of the nuclear properties of these lattices, when they contain no process tube, are given in Table I. Standard methods were used in calculating these parameters.

TABLE I

	Case I	Case II
η	1.34	1.66
ϵ	1.05	1.05
p	0.79	0.62
f	0.92	0.96
k_{∞}	1.02	1.04
Conversion Ratio$_{\infty}$	1.01	1.08

Values of the thermal utilization are tabulated in Table II as a function of the process tube thickness and material relative to the value for no process tube.

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TABLE II

Process Tube Thickness	Case I Relative Thermal Utilization			Case II Relative Thermal Utilization		
	Fe	Al	Zr	Fe	Al	Zr
0.00"	1.000	1.000	1.000	1.000	1.000	1.000
0.025"	0.938	0.996	0.997	0.943	0.997	0.998
0.050"	0.877	0.991	0.995	0.889	0.992	0.996
0.100"	0.778	0.981	0.989	0.798	0.984	0.992

Evaluation of Lattice Parameters for IPR Program

Preliminary values for the resonance escape probability (p) and the conversion ratio (ICR) have now been obtained for the 1.93" O.D., 0.75" I.D., natural uranium slug in an 8-3/8" lattice. These values are given below.

Test Condition	p	ICR
(a)	0.790	1.007
(b)	0.806	0.982

(a) Coolant annulus dry, core dry.

(b) Coolant annulus wet, core dry (volume of coolant is 5.5 cc/cm of process tube)

The following are tentative, preliminary values for the 1.68" O.D., 0.5" I.D. cored, natural uranium slug in a 7½" lattice. No error analysis has thus far been made.

Test Condition	δ	ϵ	F_{th}	f	p	ICR
(a)	0.0731	1.0388	1.364	0.937	-	-
(b)	0.0718	1.0381	1.364	0.896	0.822	0.938
(c)	0.0741	1.0394	1.280	0.895	0.822	0.940

δ is the ratio of the fissions which occur in U-238 to those which occur in U-235.

(a) Coolant annulus dry, core dry.

(b) Coolant annulus wet, core dry (volume of coolant is 4.6 cc/cm of process tube).

(c) Internally and externally water cooled (volume of coolant is 5.6 cc/cm of process tube).

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Buckling Measurements for IPR

A small exponential pile ($\sim$5' x 4') is being built with a lattice spacing of 8-3/8" for buckling measurements with a large 1.66" diameter natural uranium slug. This will be the first of a series of buckling measurements in the small exponential piles for the IPR program; these buckling measurements are to supplement and extend the PCTR experiments.

PCTR

The PCTR operated during the month on a two-shift basis. There were thirteen unscheduled shutdowns during the month, four were caused by operator errors, eight by electronic equipment failure, and one by an unscheduled power outage.

The PRP experiments on the 7-inch lattices were completed during the month.

The experiments on the 1% $UO_3.4H_2O$ were completed during the month.

The tank for the 8-inch lattice for the PRP experiment has been installed.

Unusual maintenance item: One track for the concrete shield door was raised 1/8 inch to stop the door from binding against the concrete shield wall.

TTR

Three reactivity measurements were made to determine the temperature coefficient by varying the moderator density in the fuel tubes while the temperature of the reactor was held constant. Three densities of kerosene-paraffin oil mixtures were used as the moderator. One unscheduled shutdown caused by improper trip setting occurred during the month.

Heating the reactor to obtain the overall temperature coefficient reported in April 1957 baked some poisons (oil, water, etc.) from the graphite in the core. This in addition to a better method of removing bubbles from the fuel tubes, by pumping a vacuum on the tubes while the fuel assemblies are moved up and down, caused a reactivity gain sufficiently large that 15 additional fuel disks were removed to reduce the excess reactivity below 60 cents. The critical mass of the TTR is now approximately 2.59 Kg.

A pressure coefficient was measured with relatively few bubbles in the fuel tubes. This coefficient was -0.012 cents/mb compared to + 0.025 cents/mb when a large number of bubbles are present.

A sodium-beryllium photoneutron source was irradiated for the purpose of leak testing the source before being irradiated in a high flux.

SEPARATIONS

Criticality Experiment

Experiments were conducted in the PCTR on the second phase of the criticality experiment; this is the buffer-thickness study. The problem is to determine how thick the buffer region must be in order to obtain a measured value of

k_{oo} which is independent of further increases in the buffer thickness. For accurate results the incident neutron flux on the test cell or core section must have an energy distribution which is characteristic of that which would be established in an infinite system of the same material.

k_{oo} was measured for a core tank containing a 1.00% enriched, UO_3-H_2O mixture at an H/U atom ratio of about 8. The measurements were taken with three different buffer tanks surrounding the test cell; these tanks were approximately 2, 4, and 6 inches in thickness. The analysis of these measurements has not been completed. Measurements were also taken from which an approximate k_{oo} is being obtained for 1.00% enriched uranium at an H/U ratio of about 7, and for 1.07% enriched uranium at an H/U ratio of about 8.

Dissolver Problem

New dissolvers have been proposed by CPD for the processing of irradiated fuel elements which have an initial enrichment of 0.94%. In order to establish the safe design limits for these dissolvers it is necessary to conduct exponential type (sub-critical) measurements with enriched uranium rods and uranium nitrate solution. The buckling will be determined for enriched uranium nitrate solutions of several different concentrations and for heterogeneous enriched uranium lattices which are reflected with enriched uranium nitrate solutions; from the latter measurements the reflector savings of the nitrate solutions will be evaluated.

In connection with this experiment, about 3000 pounds of 1.00% enriched uranium is needed to form a uranium nitrate solution for reflector studies and buckling measurements. Uranium of this enrichment is being obtained from existing supplies of scrap material by blending 0.94% enriched uranium with 1.44% uranium to make up the 1.00% material for the nitrate solution.

Critical Mass Facility

The scoping of the critical mass facility (with members of the Facilities Engineering Operation of CPD) was continued. In this work, attention has been directed to providing a minimum portion of the proposed critical mass laboratory which will permit criticality studies to be initiated. The minimum facility is being designed so that it may be expanded into a much larger system when required by increased scope of the program.

The scoping studies have given additional support to the use of a steel structure (sphere or portion of a sphere) as the reactor building. This type of structure ensures containment and ease of decontamination at a minimum of cost. To enhance the ease of decontamination of the reactor building, mixing operations will not be conducted there. A separate building adjacent to the reactor building will be provided for this function; the latter will also house change rooms for SWP work.

The concept of using a large trailer for a control center, removed an appropriate distance from the reactors, is still retained. It is planned that an earth shadow shield around the reactor building and distance will provide radiological safety to personnel in the surrounding area in the event of a burst. Calculations of the dosage from scattered neutrons and gamma rays from a burst

have been made as a function of distance from the reactor. A burst of 3×10^{18} fissions was assumed for these calculations. On the basis of this work it is recommended that all personnel in the area be a minimum distance of 200 feet from the reactor building when reactors are in operation.

An instrument layout for operation of the reactors is being prepared for estimating purposes. Security requirements for this facility are also being worked out with local security personnel.

The hazards of bursts with different types of fissile material in different physical forms and under the condition of slow assembly are being studied.

Neutron Age Measurements

Several of the Na-Be photoneutron sources for these measurements have been fabricated following the successful application of Be soldering techniques. It is planned to test the integrity of the solder joints using low level irradiations in the TTR.

Nuclear Safety Problems

Work continued on setting up design criteria for nuclear safety in processing power reactor fuels.

Critical mass limits for new plutonium metal dissolvers were established.

Design criteria to insure nuclear safety for the design of the RMC line in 234-5 Building have been established and the results summarized in HW-50232 "Process Specifications for RMC Fabrication Line Design" (by W. G. Browne). Comment prints on this project are being reviewed as they are issued.

A study of the addition of soluble poisons to slightly enriched uranium systems has been made and reported in HW-50156. The addition of small quantities of a soluble boron compound to large dissolvers can make them safe for the processing of arbitrary amounts of 0.94% U-235 enriched fuel elements irradiated to arbitrary plutonium content.

A study is being made of the design of new Task IV furnaces in the existing 234-5 Building line to increase safe batch sizes.

Nuclear safety criteria have been prepared for the design of a continuous anion exchange system for Purex. The original design of the Purex ion exchange system was based on a cation exchange process.

Vessel drawings for the Recuplex conversion project are being reviewed for nuclear safety.

INSTRUMENTATION AND CONTROL

Analog Computer

Major modifications on the computer were made by the Goodyear service personnel between April 23 and May 1. Though these modifications corrected most of the operating troubles, malfunctions still exist. Goodyear Aircraft has been noti-

fied as to the nature of the malfunctions and will continue to supply the necessary service.

The four problem boards for the Hanford computer have arrived. The two problem boards on loan are being returned.

Because the original patch cords supplied with the computer have proven unsatisfactory, Goodyear is replacing the complete set.

Initial contacts have been made with the Advance Engineering Group and programs are being established to utilize the computer for PRPR studies.

A series of informal talks describing the Analog Computer, its operation and fields of use are being prepared. It is planned to give these talks to all interested groups to acquaint Hanford personnel with the Analog Computer services available to them.

Components Research and Development

Development continued on the experimental detecting system for the determining of low energy limitations of scintillation X-ray and gamma detection. The fabrication was completed on an experimental model and initial tests indicated significant noise reduction. The concepts of cross-correlation are being utilized to obtain improved signal-to-noise ratio at low energies.

REACTOR DEVELOPMENT - 4000 PROGRAM

STUDIES RELATED TO THE PLUTONIUM RECYCLE PROGRAM

PCTR Lattice Measurements

The PCTR measurements on the first heavy water moderated lattice investigated for the PRP have been completed. This first lattice study was done on cluster fuel elements arranged on a hexagonal lattice with a seven-inch spacing between centers. The cluster fuel assemblies were made up of rods of natural uranium oxide prepared by the Ceramic Fuels Development Operation. The effects of plutonium enrichment were studied by replacing UO_2 rods with rods of Pu-Al which were prepared by the Plutonium Metallurgy Operation. The UO_2 rods were 0.504 inches in diameter of UO_2 of a density of 10.1 g/cm^3 and were clad in aluminum cans with 30 mil wall thickness. The Pu-Al rods were fabricated of 1.80 weight percent plutonium in aluminum clad in Zr-2 cans with 30 mil wall thickness. The cluster fuel elements were contained in 1/8 inch wall aluminum process tubes 3.5 inches in outside diameter. The process tubes are centered in the 3.75 inch I.D., 1/8 inch wall shroud tubes of the D_2O calandria.

Several fuel configurations were investigated. The first of these was a 7-rod cluster of UO_2 elements arranged on a hexagonal lattice with a spacing of 0.648 inches between centers. Measurements of k_∞ and thermal utilization were made on this cluster with an atmosphere of air in the process tube (dry). The second configuration consisted of adding 12 UO_2 rods around the 7-rod cluster on a radius of 1.252 inches. These rods were uniformly spaced and were added so that pairs of rods were 0.648 inches between centers and formed nearest neighbors with a rod of the central hexagon. The third configuration consisted

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of replacing three alternate rods of the central hexagon with Pu-Al rods. Measurements were made on the 19-rod clusters both dry and with the process tube filled with D_2O (wet).

Preliminary values of k_∞ and thermal utilization for the UO_2 elements are:

	7-Rod Cluster UO_2	19 Rod Cluster UO_2	
	Dry	Dry	Wet
f	0.823	0.907	0.901
k_∞	0.992	1.011	1.005

The errors in the k_∞ values are estimated to be about $\pm$ 0.3%.

The analysis of the Pu-Al cases are delayed by the time-consuming job of determining the neutron absorption rate in the Pu. A normalization experiment has been performed in the very thermal D_2O calandria using a foil rotator. These results will allow a comparison of the power production in the Pu rods to that in the UO_2 rods. A preliminary analysis of the data gives a k_∞ of about 1.065 for both the wet and dry cases of 16 UO_2 - 3 Pu-Al clusters.

The 8-inch D_2O lattice calandria has been fabricated, installed in the PCTR and the experimental measurements have begun.

Nuclear Safety Problems

Safe spacing of Pu-Al fuel elements in storage racks has been calculated for the PRP.

BIOLOGY AND MEDICINE - 6000 PROGRAM

BIOPHYSICS RESEARCH

Atmospheric Physics

Two full-scale diffusion experiments were completed and analyzed during this month. The first, an early-morning experiment designed to measure the diffusion and transport of stack gases in stable atmospheres, was one of a continuing series of experiments which provide estimates of the vertical diffusion rate in stable atmospheres. The data collected so far have permitted the planning of an experiment for measuring the vertical distribution of concentration out to at least two miles from the source.

The second experiment was designed to measure short- and long-period average ground-level concentrations over a grid which extended out to one-half mile from an elevated point source. This experiment was conducted in a slightly unstable atmosphere. The data obtained were also part of a continuing study of the diffusive capacity of the atmosphere and permit the experimental determination of the relationships between acute and chronic concentrations or exposures.

Operation of the wind station network continued on a satisfactory basis and the

1103741

data collected from this network were reduced on a routine basis. A summary of wind speed and wind direction observed at the Meteorology Tower and in the vicinity of the 100-B Area was supplied to Mr. A. T. Gifford, HOO-AEC at his request.

DOSIMETRY

Difficulties developed in obtaining good optical coupling and light tight seals in the modified coincidence scintillation counter for plutonium detection. These appear to be overcome by use of a water soluble cement to fasten all the components together in a fairly rigid structure which can be covered with light-tight material.

Samples of serpentine and similar commercially available ultrabasic rocks were obtained from Oregon and Washington Bureaus of Mines to be tested for radioactivity to see if they could be used as cheap temporary shielding materials.

The positive ion Van de Graaff developed what at first appeared to be a vacuum leak. The poor vacuum was finally found to be due to a layer of ice on the cold traps which prevented their proper functioning. The ice is attributed to excess moisture in the air from the building air conditioning. Aside from this difficulty, the accelerator was in good operating condition during the month. The voltmeter and integrating capacitor of the beam current integrator were replaced by better components which resulted in an improvement of more than an order of magnitude in the reproducibility of the readings. The Van de Graaff was used to determine the neutron response of a detector produced by Radiation Protection Instrument R & D Operation. The response was approximately proportional to dose between 1 and 5 Mev but dropped sharply below 1 Mev. This is to be contrasted with the moderated detector dosimeter with dose response down to about 0.1 Mev. Possession of two instruments with complementary properties in the 0.1 to 1 Mev region presents an opportunity for study of an old Hanford problem, a problem fundamental to further development work: what proportion of the fast neutron dose typically is delivered by neutrons below 1 Mev?

The ionization chamber and associated circuitry to be used to measure w for protons was improved and tested as much as it could be in the laboratory. It was then attached to the Van de Graaff system to complete the testing under actual experimental conditions.

The measurement of w for Co^{60} gamma ray secondary radiation in air was completed except for the computation of a small correction for the difference between exposure dose and absorbed dose in the ionization chamber walls. The value obtained for air was 32.5 ev per ion pair. The isotopic fractionation ratio of tritiated water upon vaporization was measured to be 0.85. A small correction for enrichment of the liquid phase remains to be made. The above fractionation ratio gives w for tritium beta particles in air as 32.8 ev per ion pair.

In response to a request from the Calibrations Operation, a study of the beta-ray calibration of film badges is being made. Theoretically, one expects that emulsions exposed to equal absorbed doses of beta rays or high energy gamma

rays would have the same photographic density. Experiments made together with Exposure Evaluation and Records Operation showed that for uranium and Sr^{90} the darkening was about 25% higher for beta rays. This may be due to low energy bremstrahlung accompanying the beta rays.

In cooperation with Industrial Medical and Radiation Monitoring Operations, a study was started of the gonad dose of the local population from the diagnostic use of X-rays.

Biology Operation was assisted in the design of an irradiation experiment for the study of genetic effects in Drosophila.

The theoretical study of the dose rate at the surface of an emitting material of high atomic number was improved by an allowance for backscattering. The dose rate at the surface of plutonium was calculated as a function of MWD/T received by the uranium. At 10^4 MWD/T the total surface dose rate from x and gamma radiation should be about 4.3 rad/hr, increasing to 6 rad/hr in five days after separation. The "hard" component is 0.2 and 1.9 rad/hr respectively, which indicates that there is much to be gained by processing the material quickly. The neutron surface dose rate at 10^4 MWD/T should be 0.9 rem/hr.

INSTRUMENTATION

The wind direction circuitry and servosystem for the Radiotelemetering System was developed and an experimental model tested. The drawings were forwarded to the Construction Engineering Operation. Circuit development for the Central Station System was started and portions of the circuitry have been completed.

The Fast Neutron Scintillation Exposure-Rate Meter has been tested using the positive ion accelerator with various targets and using Po-Be and Ra-Be sources. The instrument detector "threshold" is approximately 300 Kev (neutrons). The portion of the energy response curve from 1.0 mev to 5.2 mev is flat to within ± 10% with an average sensitivity of about 100 c/m/mrad/hr making the instrument, in portable use, essentially energy independent from 1.0 mev to 5.2 mev or higher.

The scintillation fixed-filter Alpha Counter (installed experimentally) has been accepted and five more similar units are on order by 234-5 Radiation Monitoring personnel. This instrument counts 4" x 4" and 4" x 8" air filters for alpha contamination.

Experimentation and fabrication was continued on the Transistorized Scintillation Alpha Hand and Shoe Counter. This instrument is being developed to replace the "Four-Folds" and will use all transistors in the circuitry with phototube detectors.

An experimental Dust Meter using a critical flow orifice and a bare charge collecting wire was fabricated and delivered to the Atmospheric Physics Unit for testing and comparing with their impactor dust collection device. Work was continued concerning dust particle size to pulse-height relationships and concerning multiple-hole critical orifice flow. The proper air flow for a single critical orifice as used was found to be 0.26 cfm.

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1103743

An estimate was completed for the fabrication of one Savannah River-type continuous moving tape impactor Alpha Air Monitoring System. The system will be evaluated for possible use at Hanford.

Three Transistorized Alpha Scintillation Portable Meters were fabricated and are being tested along with three Transistorized G-M Meters. These instruments embody plug-in printed circuitry with similar and interchangeable components.

Four Scintillation Exposure-Rate Meters were fabricated and are being tested. These employ a 1.0-mm-thick NaI crystal and a 0.030-inch-thick tantalum shield to give approximate gamma dose rates from 50 Kev to 5.0 Mev with a response over that range energy independent to within ± 10%. The sensitivities of the instruments are 100 times that of a regular CP or 0 to 0.5 mr/hr maximum with ranges to 5.0 R/hr on both linear and logarithmic instruments.

Evaluation tests were completed on three prototype battery Scintillation Alpha Poppies of an order of thirty, and on five prototype Samson portable ion chamber instruments of an order of twenty-two. Also completed were evaluation tests on Halogen GM-tubes and on a vibrator-type high voltage supply.

CUSTOMER WORK

Weather Forecasting and Meteorology Service

Type of Forecast	Number Made	% Reliability
8-Hour Production	93	83.0
24-Hour General	62	85.2
Special	170	85.9

Summary of the Weather

The average temperature of 65.9 was 3.2° above normal. Total precipitation of 0.82 inches, all of which occurred during the first 20 days, was about twice the monthly normal. There was no severe weather although thunder storms occurred on 4 of the first 8 days of the month.

165-KE Stack Study

In response to a request from Irradiation Processing Department engineering personnel, an experiment designed to determine the optimum stack height for the oil-fired furnace off-gases in the 165-KE Building was performed on May 20. The major problem under consideration was the re-entry of the off-gases through the 190-KE air intakes. An array of smoke pots was flown at 20-foot intervals up to eighty feet above the 165-KE roof level and side photographs of the resultant plumes were taken. The data collected, considered with other pertinent information, suggested strongly that a stack height of fifty feet above the 165-KE roof level would reduce the re-entry of off-gases to well below acceptable levels. This recommendation was postulated on the basis of no change from present stack draft and effluent temperature.

Columbia River

Forecasts of the peak flow and crest height of the Columbia River were veri-

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fied when the flow rate peaked at 429,000 cfs on May 27, 1957. As forecast, no serious flooding occurred in the vicinity of the Hanford Works.

Optical Service

A 16-mm microfilm camera operated by the Records Center of the Relations and Utilities Operation was not giving the desired resolution. A study of the developed films indicated either a poorly designed lens or an out-of-focus lens to be the cause of the trouble. Several new spacer rings were fabricated to adjust the focus. Photographic tests are now being made to determine if sufficient improvement is gained through adjusting the focus.

Detailed suggestions were presented to the Facilities Engineering Operation of the Chemical Processing Department outlining the possibilities of using an optical inspection jig for determining the acceptability of a weapons component. The proposed optical jig was not found acceptable. It was decided to add a microscope to the present inspection jig to assist in aligning the piece to be inspected.

A microscope was designed for the Equipment Development Operation of IPD to assist in measuring the movement of a resistance-type temperature detector stem-tip at varying water flow rates in the "Y" fitting on the face of a pile.

The routine optical shop work included the fabrication of glass bearings, quartz plugs, a microscope, a vycore filter, several glass filters, two lucite spherical cavities, two glass sample holders, and a surface viewer. Also, servicing work was completed on two microscopes, a hand level, and an underwater viewer.

Paul F. Gast

Manager
Physics and Instrument Research
and Development
HANFORD LABORATORIES OPERATION

PF Gast:mcs

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VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented & Address	Reason for Visit	H. W. Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
Prof JL Powell	May 13-17	University of Oregon Eugene, Oregon	Consultation	JE Faulkner	Yes	300: 326 303

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
HW Lefevre	May 1 May 2	ANL, Lemont, Ill. Radiation Counter Laboratories Skokie, Ill.	Discuss instrumentation " "	FJ Lynch CJ Walsh	No No
WC Roesch	May 2-3 May 31	University of Wash. Seattle, Wash.	Teach AEC fellowship students.		No
GW Stuart N Ketzlach	May 13	Rocky Flats Plant Dow Chemical Company Denver, Colo.	Discuss nuclear safety of metal fabrication processes.	CL Schuske	Yes
J De Pangher	May 16-17	University of Wash. Seattle, Wash.	Teach AEC fellowship students.		No
IT Myers	May 9-10	University of Wash. Seattle, Wash.	" " "		No
	May 23-24	" "	" " "		No
IT Myers	May 11-15	Radiation Society Meeting, New York	Present paper.		No
IT Myers	May 16-17	Dr. Wheatley Urbana, Ill.	Discuss dosimetry.		No

1103746

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Chemical Research & Development Operation

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ORGANIZATION AND PERSONNEL

Dr. William W. Mills, Chemist, Chemical Research Operation retired. He is the first professional employee to retire from the Chemical Research & Development Operation.

Mr. Doyle M. Hunnicutt, Chemist, transferred into the Analytical Laboratories Operation from Construction Engineering Operation.

Mildred K. Black, Laboratory Assistant, transferred into Analytical Laboratories Operation from Exposure Evaluation and Records.

D. K. Potvin, Steno-Typist, was hired into Chemical Research Operation.

A. C. Jirus, Secretary, transferred out of Chemical Research Operation to Fuels Development Operation.

Two Technical Graduates transferred out and two transferred in during the month.

FISSIONABLE MATERIALS - 2000 PROGRAM

REACTOR EFFLUENT STUDIES

Analytical Chemical

Direct measurement of isotopic content of reactor cooling water by gamma spectrometry will be delayed about one month. Thirty-five comparisons with beta measurements gave Na-24 and Mn-56 average biases of + 10 per cent and + 6 per cent. Np-239 values were not biased but widely scattered.

Ag-110, an isotope with a complex gamma energy spectrum, was found in a sample of KER recirculation loop coolant. Any widespread occurrence in reactor effluent coolant would seriously complicate gamma spectrometer measurement of Cs-137, Sc-46, Mn-54, Co-58, and Fe-59.

Measurement services covering organic coolant properties were expanded and improved. The Karl Fisher water method was installed. Cloud point, pour point, and thermal conductivity determinations became more rapid due to equipment improvements.

IRRADIATION PROCESSES

Canal-Lake System Evaluation

Pumping tests were performed on two additional wells in the area north of Gable Mountain that would be affected by an inland lake effluent handling system. A well near plant coordinates N 65,000, W 50,000 indicated a local transmissibility coefficient of 480,000 gal/day/ft for the 35 ft. sand and gravel aquifer in that region. This correlates well with the measured transmissibility near plant coordinates N 62,000, W 43,000 indicating that the highly permeable channel north of Gable Mountain is at least one-half mile wide. Tentative data from a well near plant coordinates N 71,000, W 52,000 indicate that the channel does not extend that far north. Thus, the permeable gravels in which the proposed lake would be formed extend from one-half to one and one-half miles north of Gable Mountain.

1103747

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Process Assistance

Experimental data showed that Turco 4306-B in a concentration of 1 ounce per gallon was 100 times as effective as reactor effluent water in placing in solution gross beta emitters associated with reactor effluent basin sludge. The same solution is only 20 times as effective as effluent water for placing Sr isotopes in solution. These experiments were designed to arrive at a maximum release of fission products which might be expected in actual practice. It is concluded that the proposed addition of Turco for five to ten minutes would produce a negligible increase in isotopes reaching the river. The interest in this commercial cleaner stems from its ability to decontaminate internal surfaces of reactor rear face piping. Reluctance to use the cleaning agent in full pile tests in which it would flow from front to rear through process tubes, resulted in the suggestion of an alternate method. In this method Turco solution would be injected into a rear riser from where it would flow counter to normal flow through cross headers and pigtails and be discharged through loosened end caps into the storage basin.

A document was prepared recommending less restrictive specifications for disposal of reactor purge effluent during seasons of higher river temperatures and will be issued shortly. Presently, purges-while-operating are not carried out during periods when river temperatures exceed 15 C. The recommended changes are estimated to result in less than 3 per cent increase in the average river concentration of P^{32} during periods when accumulation in whitefish is at a maximum.

Automatic Analyzing Monitor

The sample evaporation system was completed and initial tests indicated an adequate evaporation rate for the total 107 Water sample. Progress was made on the installation of sample pre-treatment equipment on the monitor.

Tests were performed on the count rate meter and control circuits under actual operating conditions. The experiments disclosed that the ten-second interval provided for read-out of the count-rate meter via the Weston recorder to the Streeter-Amet printer was long enough to permit undesirable additional pulses to the printer. Increasing the time constant improved the performance and gave a lower probable counting error. To reduce to a minimum the accumulation of pulses between the time the recorder has risen to the read point and the time at which the printer prints, a circuit was designed which signals for a print-out immediately after the steady read point is reached by the Weston recorder. The circuit utilizes a thyratron which actuates a relay when the Weston recorder reaches the balance point.

A review of data for the removal of contaminants, principally As^{76}, from the P^{32} stream, resulted in a CuS pre-treatment method which has given very effective decontamination in recent tests. Detailed specifications can now be written for CuS bed preparation to assure effective As^{76} removal.

SEPARATIONS PROCESSES

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PUREX

Interfacial Transfer Rates

Recent transfer rate studies have been concerned with the transfer of uranyl nitrate from a TBP phase to water, i.e., in the "stripping" process. The transfer

from a TBP solution in an inert diluent is first order with respect to the uranium and exhibits a rate constant of the same order of magnitude as previously found for the extraction process.

Also, as in the extraction process, the effect of TBP concentration is very slight. A slightly lower rate of transfer out of 40 per cent TBP over that found with TBP concentrations of 10 to 30 per cent can probably be explained by the increased viscosity.

The rate of transfer (as measured by the first order rate constant) decreased from 0.008 to 0.006 as the initial uranium concentration in the organic phase was increased from 0.15 molar to 0.3 molar. This is also a minor effect.

Addition of 100 ppm of the surfactant "triton NE" to the system decreased the rate by a factor of three. The sensitivity of rate of transfer to small amounts of surfactants is apparently characteristic of transfer in either direction.

The rate of transfer from organic to aqueous is nearly independent of the rate of mixing in the aqueous phase. Doubling the rate of mixing in the organic phase doubled the rate of transfer, however. This is just the opposite as was found for transfer from the aqueous to the organic phase. It thus appears that the rate determining step in both the extraction and stripping of uranium occurs in the boundary film of the phase from which the uranyl nitrate transfers. This would not be predicted from the dispersion coalescence studies made previously.

Purex 2A Column

Studies to determine the capacity of the Purex Plant 2A Column extraction section are being carried out in a 6-inch-diameter by 10-foot-high glass pulse column packed with 1-inch Raschig rings. Purex Phase II Flowsheet with 2AFS and 2AX temperatures of 50 C and 35 C, respectively, has been used. With a 1.1-inch pulse amplitude, the following flooding frequencies have been determined.

Flooding Freq., Cyc./Min.	Plant Capacity Factor
55 ± 5	2
38 ± 4	3
Unpulsed	4

It appears that the present plant column will not give the desired capacity factor of 4 with pulsing. However, if extraction and decontamination were satisfactory without pulsing a capacity factor of 4 would be assured. An unpulsed plant test is recommended to firm up estimates of performance which might be made from "cold" studies.

Annular 2A Column

Fabrication of an annular pulse column in which the area of the annulus is equal to that of a 9-inch-diameter cyclinder is complete except for tie-in to the 321 Building tank farm piping. Following tie-in the column will be tested under Purex 2A Column conditions.

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REDOX

Extractor-Still Studies

Conversion of the UNH concentrators in Redox to extractor-stills to replace the "C" Columns and aqueous concentrators would provide a simple means of increasing capacity since the aqueous concentrators are limiting. A laboratory-scale extractor-still was operated to obtain aqueous and organic products for chemical evaluation. Simulated Redox HAP (119 g/l UNH in hexone) was used as feed. The aqueous product (UNH solution) was evaporated and calcined to UO_3. Severe foaming, which was not significantly reduced with 200 ppm G.E. Antifoam, occurred during the calcination step. Future work will further evaluate the foaming problem with the aqueous product and also determine behavior of the organic product under extraction, scrub, and strip conditions.

Redox Through-Wall Steam Pipe Failures

Failure of several through-wall process steam lines, primarily in the Redox plant D Cell, prompted an investigation of the reason for failure. The pipes (347 stainless steel) are wrapped with corrugated paper and a layer of impervious tape. Metallurgical examination of a section of one of the failed pipes showed stress corrosion cracking as the principal cause of failure. The cracks generally were oriented longitudinally indicating quenching as the source of stresses involved.

It is believed currently that the chemical agent responsible for the observed stress corrosion cracking is chloride derived from the breakdown of the tape used to seal the corrugated paper wrapping. Oxygen-bomb analysis of tape from an unused steam line showed it to contain 19 weight per cent chlorine.

Type 33 Scotch electrical tape (believed to be the tape used in the Redox plant) exposed at 160 C for twelve days, both dry and immersed in water, decomposed and released chloride corresponding to 18-20 weight per cent of the tape. It is postulated that chloride from this source contributed to the problem. Although concrete removed from the canyon wall near one of the failed pipes contained 0.03 weight per cent soluble chloride, it is difficult to postulate a mechanism by which this chloride could become available to produce stress corrosion in the covered pipes.

At present, attempts are being made to produce controlled degrees of stress cracking in samples of stressed pipe. The purpose is to produce pipe cracked to known depths which can be used for calibration of an eddy current detector which Radiographic Testing Operation proposes to use in an examination of pipes in service to determine their condition. Progress is slow due to erratic and non-reproducible results.

Criticality Studies

Homogeneous System. The first set of 8 tanks (700 pounds) of $UO_3 \cdot 3.75\ H_2O$ (1.0 per cent U_{235}) was loaded and delivered to Reactor Lattice Physics Operations. All specifications on H_2O/UO_3 ratio were met. The preparation of 500 pounds $UO_3 \cdot 3.75\ H_2O$ (1.15 per cent U_{235}) is 10 per cent complete.

Heterogeneous System. Half of the required twenty-six hundred pounds of enriched uranium (0.94 per cent U_{235}) and 380 pounds of 1.44 per cent U_{235} metal has been received for dissolution. Dissolver maintenance is complete. Special tanks for the experiment will be completed June 1, 1957.

During the preparation of the UNH from scrap metal (U-235 - 0.94 per cent) for the heterogeneous study a near serious accident occurred. The large surface to volume of the scrap metal (turnings and chips) appears to be the source of the difficulty. After 60 pounds of 45 per cent nitric acid had been added to 259 pounds of metal the reaction rate in the dissolver suddenly accelerated. The resultant volume of gases evolved exceeded the capacity of the dissolver off-gas system. The resultant pressure buildup ejected the charging port cover. The sudden release of pressure also resulted in expulsion of a part of the dissolver contents. The uranium particles were burned in their flight from the dissolver. The semiworks area of the 321 Building was contaminated with uranium oxide particles. There were four men in the semiworks area at the time of the incident. No injuries resulted. No significant uptake of uranium by the personnel was observed from bioassay measurements. The procedure for dissolution of finely divided uranium is undergoing a complete revision.

WASTE TREATMENT AND BY-PRODUCT RECOVERY

Neptunium Recovery

Analysis of further car lots of UO_3 from current Purex production showed that the neptunium content remained low during the month of April. Work was continued to determine the relative importance of organic impurities and of nitrite oxidation in explaining and controlling the path of neptunium in the Hanford Purex plant. Research also continued on ion exchange as a neptunium isolation process.

Analyses not previously reported for neptunium-237 in the Purex uranium product are shown in the accompanying table. The dates given are equivalent Purex dates and are the date of oxide sampling less five days. On the basis of an average exposure of 650 MWD/T and a value of 0.0036 for the Np/Pu ratio, the calculated feed neptunium is equivalent to 1.5 grams per ton of UO_3.

NEPTUNIUM IN PUREX
URANIUM PRODUCT DURING APRIL

Date	Car No.	gm Np^{237}/T UO_3	Percent Feed Neptunium
4/1	27	0.24	16
4/11	28	0.32	21
4/20	29	0.33	22
4/25	30	0.19	13
4/27	31	0.32	21

Savannah River has reported that nitrite appears to catalyze the nitrate oxidation of neptunium(V) to the extractable (VI). Experiments performed during the month confirm these results, at least qualitatively, and extend them to Hanford type solvents. The extractability of neptunium was studied as a function of acidity, initial nitrite concentration, and time of contact. The effect of nitrite is shown in the accompanying table. The solvent was 30 per cent TBP in Shell E 2342 in all cases and the contact times were 30 minutes. The neptunium tracer was initially in the (V) state. It will be noted that the neptunium extraction coefficient passes through a maximum at about 0.02 molar initial nitrite. Above this concentration, it exhibits a minus one dependence on nitrite concentration.

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EFFECT OF NITRITE ON NEPTUNIUM EXTRACTION - 2 M NITRIC ACID

Initial Nitrite	Gross Np E_a^o
0	0.013
0.002	0.23
0.02	0.73
0.04	0.49
0.08	0.30
0.12	0.20
0.20	0.12

The effect of nitric acid at 0.02 molar nitrous acid, the concentration corresponding to maximum neptunium extraction, is shown in the accompanying table. The extraction coefficients of neptunium(V) and (VI) at the same acidities (but in the absence of nitrite) are shown for comparison purposes. In the presence of nitrite, the neptunium extraction coefficient was found to exhibit a 3.5 power dependence on nitric acid concentration.

NEPTUNIUM EXTRACTION AS A FUNCTION OF NITRIC ACID CONCENTRATION - 0.02 M

M HNO_3	Gross Np E_a^o	Np(VI) E_a^o	Np(V) E_a^o
1	0.10	5	0.005
2	0.83	12	0.02
3	3.13	18	0.05
4	10.6	56	0.13

Variation with time is shown in the table below. The 2 molar nitric acid - 0.02 molar nitrite solution was contacted with 30 per cent TBP - Shell E 2342 and sampled after the indicated total times of stirring. The decrease in the extraction coefficient at nineteen hours may be due to destruction of nitrite by atmospheric oxygen, or to some other change in the system.

VARIATION OF NEPTUNIUM EXTRACTION WITH TIME - CONSTANT NITRIC ACID AND NITRITE

Mixing Time	Gross Np E_a^o
10 minutes	0.35
30 minutes	0.73
60 minutes	0.86
180 minutes	1.05
19 hours	0.44

Two features of these results are noteworthy:

(1) That they were obtained with the same diluent presently employed in the Purex plant.

(2) That the neptunium extraction coefficients are sufficiently large and persist long enough to assure more or less complete recovery of neptunium in the Purex HA column.

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With regard to the above points, a very pure diluent (dodecane) was employed in the Savannah River experiments, and it was thought that an inferior diluent would result in rapid reduction of any neptunium(VI) which might be formed. The present experiments lend confidence that the nitrite catalysis can be employed to recover neptunium under plant conditions.

Studies of the anion exchange isolation of neptunium have continued. Excellent adsorption and elution curves have been obtained for neptunium-237 on a Dowex-1, X-4 column. The capacity for neptunium absorption shown by the four per cent cross-linked resin was 25 per cent of the theoretical (4.2 meq. per gram dry resin), a factor of three higher than with the ten per cent cross-linked resin previously used. Sixty-one per cent of the neptunium absorbed on the column from 8 molar nitric acid was eluted by 0.25 molar nitric acid at a concentration of 59 grams neptunium/liter in only 2.3 column volumes.

Both the adsorption-elution curves and the capacity achieved were almost identical to those previously established in this laboratory for plutonium(IV). From these results, it is calculated that a column only 6 inches in diameter by 2.5 feet long would be adequate to handle the concentrated Purex plant 2DW stream.

Gassing continues to be a problem in the ion exchange work, however, and no satisfactory solution has yet been found to this difficulty. The use of 0.1 molar semicarbazide in place of 0.01 molar ferrous sulfamate as reductant lessens, but does not eliminate, gassing with resultant drying out of the resin, increase in pressure drop, and blocking of flow. This formation of gas bubbles appears to occur on contact of the solution with the resin, suggesting that the resin either enters into the reaction or catalyzes it. This work is being continued.

A paper, "The Recovery of Neptunium-237 at Hanford," HW-50213, (Confidential), June 1, 1957, was issued during the month under the joint authorship of R. L. Moore (Hanford Laboratories Operation) and R. E. Tomlinson (Chemical Processing Department).

Fission Product Recovery

Two reports summarizing extensive work on cesium recovery were issued. These were: HW-49658, "Recovery of Fission Product Cesium from Chemical Processing Waste Solutions Containing Aluminum Nitrate," C. A. Goodall (M.S. Thesis), and HW-48830, "Recovery of Cesium from Purex Plant Wastes by Metal Ferrocyanides and Ferricyanides II. Full Level Laboratory Investigations," H. H. Van Tuyl. A third formal report, HW-46676, "Removal of Iodine-131 from Dissolver Off-Gas Streams by Isotopic Exchange," E. D. McClanahan, Jr. was also issued.

In the cesium zinc ferrocyanide process previously developed for the recovery of fission product cesium from Purex 1WW solution, iron and uranium were removed by neutralization prior to precipitation of the cesium. Due to the higher iron concentrations in the waste resulting from the new two cycle Purex flowsheet and to the finding of aluminum in some samples of plant 1WW, it was considered desirable to develop an "acid side" cesium recovery flowsheet which would permit recovery of the cesium without prior precipitation of the iron, uranium, and aluminum. Scouting experiments are being carried out to test the ferrocyanides, ferricyanides, and cobalticyanides in this application.

A synthetic 1WW solution simulating the composition of an actual plant 1WW was partially neutralized with caustic to one molar acid and aliquots treated with

several co-formed scavengers. Less than 50 per cent of the cesium was removed by 0.01 molar nickel, zinc, or ferric ferrocyanide, but recoveries of 80 to 87 per cent were obtained by increasing the metal ion concentration to 0.015 M and using a slight excess of ferrocyanide. The effectiveness of the precipitants was in the order Ni > Zn > Fe; however, the differences between the precipitants were quite small. . Precipitate volumes at the higher concentrations were about four per cent of the solution volumes. These are somewhat larger than desired, but not prohibitive.

Similar experiments were performed with the ferricyanide and cobalticyanides. Two concentration levels were used; 0.002 M and 0.007 M. The best recovery of 62 per cent was obtained with zinc cobalticyanide at the higher concentration. Zinc ferricyanide gave 55 per cent recovery. All others were under 50 per cent. Further experiments will be performed with higher concentration of reagents.

Work has also continued to establish procedures and optimum conditions for the isolation of uranium, plutonium, strontium, cerium, rare earth, zirconium-niobium, and americium activities from Purex 1WW. This program is aimed at firming up the "Integrated" flowsheet which was proposed earlier for recovering these activities in conjunction with cesium removal as cesium zinc ferrocyanide. Analytical difficulties have rendered firm conclusions difficult at some points, however substantial progress has been made on this difficult problem.

Americium has been traced through the Integrated flowsheet and found, as expected, to follow the rare earths. Effort is now being directed at developing a satisfactory means of separating americium from the rare earths. It was found that 20 to 30 per cent of the americium is precipitated with cerium in the iodate precipitation currently used to separate cerium from the other rare earths, implying that americium would need to be removed prior to cerium removal. Ion exchange appears to be an attractive means of effecting the separation. Americium and the rare earths were adsorbed on a Dowex-50, X-4 resin and various eluting schemes tried. Citric and lactic acids separated the americium from most of the rare earths except promethium. However, 13.5 molar hydrochloric acid eluted americium ahead of the rare earths. The use of an anion resin (with thiocyanate complexing) and solvent extraction are also being investigated.

Cesium Isolation and Packaging

"Flowsheet No. 1 Cesium Isolation and Packaging," HW-50241, was issued.

The calcination of zinc cesium ferrocyanide requires temperatures in excess of 400 C. Previous work has shown that, in the calcination of cesium zinc ferrocyanide, the presence of nitrate may produce explosions, when the nitrate concentration of the mother liquor contained in the centrifuged solid exceeds 0.3 moles nitrate per mole of zinc cesium ferrocyanide. Further studies of the calcination step have revealed that a non-explosive nitrate - cyanide reaction occurs between 250 and 400 C even though the nitrate concentration is less than 0.3 moles per mole of zinc cesium ferrocyanide. This reaction at low nitrate concentrations is evidenced by a sharp temperature rise, no explosive effects are evidenced.

Centrifuging and settling studies show that severe peptization of the solid occurs when washed with water and residual sodium nitrate in the mother liquor is less than 0.05 M; satisfactory settling or centrifugation is not possible. Adequate nitrate removal can, then, be obtained only by use of a centrifuge permitting very close skimming of supernatant liquid or by use of non-nitrate-containing ionic washes.

Both dilute (0.05 M) sulfuric acid and ammonium carbonate may be used as ionic washes. Following calcination of cesium zinc ferrocyanide washed with either of these reagents, no iron or zinc was detected in water leaches of the residues. Separan was not effective in preventing peptization of cesium zinc ferrocyanide in water but Super Filtrol effectively coagulated it. Calcination of the cesium zinc ferrocyanide-Filtrol mixture produced a finely divided powder of good form for leaching.

Overheating during calcination can cause an undesirable reaction resulting in vaporization of cesium oxide. This reaction occurs between 750 and 900 C and would result in low cesium yields caused by losses to the off-gas system.

Electrolytic Processing of Waste

In a continuing study of methods for waste volume reduction directed at both fission product recovery and ultimate storage of high-level wastes, the electrolytic process was reviewed. In this process the nitrate is reduced electrolytically to form volatile gases (NH_3, N_2O and N_2) and sodium is recycled as the hydroxide for further waste neutralization. The cost study showed that the high power consumption with a ten year amortization of the capital costs does not provide attractive economics even when waste storage costs of $1 per gallon are assumed for future Purex wastes. Such a process cannot therefore be considered for Hanford application under present conditions.

Special Geological Studies

The success in reduction of drilling costs and in increasing the rate of drilling by the Hatch Drilling Company and the US Geological Survey on Project CA-700 resulted in the transfer of wells from the proposed FY 1958 program to the CA-700 Project. This improves the FY 1957 and FY 1958 construction budget items by reducing the well needs for FY 1958 by drilling the planned wells on the authorized CA-700 project funds, and will permit procurement of necessary geologic data some six months earlier than originally planned. Both well drilling contractors are operating close to or ahead of the requested completion schedule. Two wells originally deferred from the fixed-price portion of the CA-700 project, and five wells deferred on the US Geological Survey portion of the project were reinstated on that project, in addition three wells from the planned FY 1958 program were added to the US Geological Survey portion of the CA-700 project.

Preliminary negotiations with Geophysical Service, Inc. for the planned seismic evaluation survey were completed by the AEC. Study of the problem by both parties indicates that the desired work can be accomplished for the requested $50,000 by close cooperation between concerned parties.

Disposal to Ground

A preliminary experiment was conducted to attempt to create a "permanent seal" in a soil column; results indicated that sodium silicate solution added to a soil column that was pretreated with calcium chloride solution formed such a seal in 24 hours. No liquid moved through the column during one month's observation. This treatment apparently produced a calcium silicate gel, which effectively plugged the soil pores. This type of treatment is under consideration as a possible method for creating permanent underground storage basins for radioactive wastes.

The possibility of direct disposal of aluminum coating waste to the ground is suggested by recent analytical results indicating that the adsorption by soil of Sr^{90} in aluminum coating waste supernate (105-C tank) was adequate for ground disposal. If the results of experiments which are now in progress with other coating waste supernates confirm the findings to date, Co^{60} will be the radioisotope limiting direct disposal of aluminum coating waste supernate to the ground. If a method can be devised to reduce sufficiently the concentration of Co^{60} in aluminum coating waste without altering the adsorption characteristics of Cs^{137} and Sr^{90}, direct disposal to the ground may be possible.

Laboratory experiments with recent samples of A-8 (Purex) condensate waste indicated that breakthrough of Sr^{90} should occur at approximately 7.4 column volumes. This breakthrough was a reduction from the estimated 13 column volume capacity of the crib reported for the waste that was being produced last December. The reduction in estimated capacity was due primarily to a 10-fold increase in the concentration of Sr^{90} in the A-8 waste. The A-8 crib had received approximately 5.6 column volumes of wastes as of March 31, 1957, one column volume corresponding to 31.7 million gallons. The useful capacity of the A-8 crib would be about 75 per cent depleted based on the 7.4 column volume capacity estimate; however, this estimate very likely is a somewhat conservative figure inasmuch as the 10-fold increase in Sr^{90} probably was a gradual increase over an interval of a few months.

Approximately two million gallons of TBP scavenged waste supernate having a Co^{60} concentration greater than 4×10^{-4} μc/cc were discharged to the 216-BC trenchsite during the month. This brings the total volume of scavenged waste disposed of on a specific retention basis at this site to 13.5 million gallons.

Two of the first three batches of in-farm scavenged supernates contained Co^{60} in concentrations appreciably above the limit of 4×10^{-4} μc/cc which has been recommended as the maximum concentration for disposal to the 216-BC cribs on a test basis. The third batch has a Co^{60} concentration of 1.2×10^{-4} μc/cc, and low concentrations of cesium and strontium. Results of soil column tests will determine if this waste is suitable for cribbing. HW-50132 (Unclassified), "Proposed Use of Test Wells to be Installed as Part of the High Cobalt^{60} Scavenged Waste Disposal Tests," was issued May 7, 1957. This document outlines proposed geological and hydrological tests and monitoring and analytical requirements concerned with the test disposal of high Co^{60} scavenged wastes at the 216-BC cribsite.

A sample of water from the 299-E33-4 well at the 216-BY scavenged waste cribsite was submitted for determination of cyanide ion. The analytical method employed would have converted ferrocyanide ion present to cyanide, hence, results could not be interpreted unequivocally in terms of cyanide ion. Concentrations to 230 ppm reported as cyanide were found with most of it concentrated in the solids fraction of the sample; clear supernate contained 30 ppm. A concentration of 10 ppm was found in a well 100 feet distant. The permissible limit for ferrocyanide ion is much higher than that for cyanide.

Observation Wells

No significant changes occurred in the distribution of radioactive contamination in the ground water. Strontium-90 persisted in the ground water beneath the abandoned 216-S-1 and 2 cribs. Ground water in the vicinity of the BY crib site showed increasing Co^{60} concentrations to a new maximum of 10^{-3} μc/cc. This is interpreted as evidence that the sediments beneath these cribs are still draining into the ground water, although no waste has been discharged to the site for many months.

Previous ground water monitoring data that indicated Cs^{137} breakthrough beneath the 216-A8 crib and the 216-S7 crib were not confirmed upon resampling. It is now believed that the former results were in error, possibly because of cross-contamination in the laboratory.

Process Development

The feasibility of using ion exchange resin columns to remove Sr^{90} from condensate wastes was investigated further. The use of small resin columns (1.3 grams of resin) resulted in constant leakage of a small concentration of Sr^{90} through the column. Plans were made to use larger columns in the laboratory to minimize leakage. Information relative to the characteristics of Duolite C-3 resin, the resin tentatively selected for use on Hanford wastes, indicated that the resin should be treated with hydrochloric acid before use to convert it to the hydrogen form and also that the capacity of the resin probably was sufficient to permit resin columns to compete with ground disposal on an economic basis. Plans were made to obtain experimental data to evaluate the economics of resin vs. soil column usage.

Gelling of Wastes - Field Work

An experiment was underway to determine moisture loss from the gel to soil. A six-inch diameter lucite tube was partly filled with soil, then aluminosilicate gel added to a depth of one foot. After nine days the soil was wetted to a depth of 32 inches, and the gel volume had decreased to two-thirds of the original volume. The top three inches of gel has become quite moist with free liquid visible on the top and sides of this section. Lower portions of the gel retained their original appearance. It is planned to determine total liquid content of the wetted soil when penetration is complete. Data will be used in predicting the extent of moisture penetration and gel volume reduction in the field.

A report (HW-50198) was issued reviewing the economics of disposal of coating wastes as aluminosilicate gels. Although rather elaborate site preparation and covering provisions were assumed, the method is still attractive from a cost standpoint.

The feasibility of blending high level wastes with aluminum coating wastes prior to gelling is under study. Heating of the gel from radioactive decay of the waste is one phase of the problem being considered together with the resulting chemical and physical effects on the gel and its environment. Although heat transfer data on the gel and the dried solids resulting are not accurately known, preliminary calculations indicate that temperatures could be reached which may volatilize fission products. The assumptions were made that a high level Purex waste stream would be combined with metal coating waste in plant stream proportions and the resulting solution gelled in batches equivalent to one ton of metal. The gel was assumed to form a sphere and be disposed by placing deep in soil. Maximum temperatures ranging from about 900 F to 4500 F were estimated depending upon the average radius assumed and the heat conductivity assigned to the gel mass, the higher temperatures resulting if a minimum sphere diameter and low heat transfer coefficient of the gel are assumed.

These preliminary estimates suggest that such wastes disposed underground as gels would first dry then the temperature would continue to rise for about 100 days, then decrease over a long period of time; the maximum temperature may possibly be high enough to calcine the gel materials, or convert them to a glassy solid. Much experimental work would be required before full potential and limitations of this disposal concept could be realized.

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Waste Self-Concentrator Prototype

During the month, the liquid level in the tank was reduced to approximately eight feet. This corresponds to 21 per cent of the original volume charged to the tank, and a sodium ion concentration (if solution were homogeneous) of 27 M. The tank wall thermocouples continued to record a steady rise in concentrate temperature. The 0.6 foot thermocouple showed an increase of 26 F to 328 F. The other thermocouples indicated similar increases. The condensate rate gradually fell off during the month, resulting in an overall average rate of 7 ml/min. The reduced rate could be attributed to fission product aging. No "bumps" were recorded during the month.

ANALYTICAL AND INSTRUMENTAL DEVELOPMENT

Mass Spectrometry

The gain of the electron multiplier collector of the thermal emission mass spectrometer has been very constant at about 10^4 for several months. This multiplier has now been replaced with another multiplier which has a gain about 100 times greater. With the higher gain, pulse counting methods which will result in higher precision of analysis can be used.

Experiments in uranium isotopic analysis by the thermal emission method were continued and a precision of ± 0.6 per cent (standard deviation for a single determination) is being obtained at U-235 to U-238 ratios in the regions of 0.04 and 15 whereas previously this precision level was obtained only at ratios near one.

Spectrographic Analysis

A method has been developed for the determination of tin, iron, chromium, and nickel in zirconium alloys. The procedure consists of a.c. spark excitation of the alloy sample directly using a graphite counter electrode. Four zirconium alloy standards obtained from the Bureau of Mines laboratories in Albany, Oregon, were used for calibration. Although the standards appear to be metallurgically very uniform, the chemical and spectrographic data supplied by the Bureau of Mines laboratory were inconsistent. Accordingly, the standards were re-analyzed chemically by the Analytical Laboratories Operation. This new data is much more consistent, resulting in straight line spectrographic working curves. In the case of the tin values, a bias of about 20 per cent exists between the calibration curves from the Hanford and the averaged Bureau of Mines data. This bias is also evident when the results of sample analyses from both laboratories are compared. There is no significant bias for the other three elements.

The data from repetitive analysis of the standards by the spectrographic method was treated statistically to give the following expected precision for the method:

Element	Standard Deviation Per cent
Fe	± 1.4
Sn	± 2.5
Ni	± 4.3
Cr	± 6.8

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Statistical and Mathematical Research and Development

Work continued on the formal report on the statistics of estimating the ratio of two counting rates.

Possible application of first passage time theory for Uhlenbeck Processes was considered for several HAPO problems.

The paper entitled, "An Optimum Sampling Technique" prepared by K. B. Stewart for presentation at the annual AEC Accountability meetings in June has been completed.

data.

OFFSITE VISITS AND VISITORS

C. A. Bennett conducted a session on Operations Research at the Pacific Northwest Regional Meeting of the American Society for Engineering Education at Pullman, Washington on May 10, 1957.

W. F. Stevenson spent May 21, 1957 at Schenectady with the Statistical Methods group of the General Engineering Laboratory conferring on the use of computers in connection with statistical problems, and attended the Eleventh Annual ASQC Convention at Detroit, Michigan on May 22-24.

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Carl A. Bennett, Manager
OPERATIONS RESEARCH & SYNTHESIS

CAB:jbk

RADIATION PROTECTION OPERATION MONTHLY REPORT - MAY, 1957

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A. ORGANIZATION AND PERSONNEL

Organization

There were no significant changes.

Force Summary	4-30-57	5-31-57
Exempt	41	41
Non-exempt	198	195
Total	239	236

B. ACTIVITIES

Radiation Monitoring

Particle contamination was encountered at the major construction site for Auxiliary Radio-iodine Removal and Nitric Acid Recovery Facilities. Major construction equipment was successfully decontaminated. High dose rates continued to prevail on the Redox contamination control project; a maximum of 5 rads/hour was encountered in the craneway. Monitoring the CG 558 modifications at 100F and 100H continued. Dose rates exceeding 5 rads/hour including 4 r/hour were encountered on particles.

A spill of Ra DEF solution in the 329 Building contaminated the floor to 3.2 rads/hr. Monitoring of work on HAPO-184 samples in 3706 indicated dose rates of 20 rads/hour. A fire occurred in the 231 Building. Approximately 200 grams of plutonium turnings were burned. There was no spread of contamination outside the hood.

The injection of Zn^{65} into steers was continued by Biology Operation. Maximum hand dose rate encountered was 15 r/hour.

An explosion occurred in a dissolver cell in the 321 Building. The spread of detectable contamination was confined to the building although adjacent facilities were evacuated as a precautionary measure to avoid exposure to fumes of nitrogen oxides. Bioassay results indicated detectable but insignificant deposition of uranium in six employees.

A detailed report of Radiation Monitoring is contained in HW-50586.

Regional Monitoring

A further decrease in the average daily emission of I^{131} was noted. The daily average was 0.6 curies compared to 1.1 curies in April. Maximum daily emission was 1.7 curies and the maximum total in any seven-day period was 7.4 curies. The Purex facility was the major contributor in both instances. Average deposition of I^{131} outside the plant did not exceed the maximum permissible limit.

Total beta activity densities in the Columbia River water were generally 40 to 60 percent of the April levels as a result of the increased river flow. Surface water

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samples collected from a cross section at mile 26 (two miles upstream from Ringold) indicated a two-fold increase in beta emitter activity density over similar measurements obtained the past three years at comparable river flow rates.

Exposure Evaluation and Records

There was one case of plutonium deposition confirmed during the month. The deposition, <1%, occurred when a grossly contaminated valve was dropped in a corridor of the 234-5 Building, causing a localized high air condition. Total cases of plutonium deposition on record is 201.

There were no new cases of fission product or other isotopic deposition confirmed during the month. Twelve employees who previously had not shown positive uranium bioassay results showed some evidence of deposition.

Bioassay results obtained from the employees involved in the incident of potential injection of plutonium mentioned in last month's report were negative.

There were two minor injuries reported this month that were caused by Pu contaminated articles. One injury, caused by scissors, was not contaminated; the second injury, caused by broken glass removed from a process hood, was found contaminated. Spot samples indicated no deposition.

Technical overexposure #115-C resulted from an employee's coverall sleeve becoming contaminated while collecting process samples in the Redox sample gallery. Autoradiographs were made of the contaminated spots and it was estimated an exposure of 3.4 rads was received by a significant skin area of the right forearm.

Technical overexposure #116-2 occurred at 100-B Area sometime during the badge period of April 26 through May 9, 1957. A film badge reading of 640 mr was obtained for the two week's period.

The study of reproducibility of past film records is near completion. A preliminary conclusion of results is that, generally, film records are in good order, reproducible, and well preserved. There is some evidence of deterioration of the insensitive film over 10 years old, but none in the sensitive film.

The 300 Area was converted to weekly reading of pencil meters during the month. Experience to date has been favorable. The revised frequency is expected to bring about sizeable future savings. Conversion to the roving badge system continued. A total of 872 were processed. The first application of exchange badges was established at the posts for central badges (perimeter barricade) and transportation personnel.

The addressograph operation has been discontinued and the equipment removed from the 3705 Building.

Sequential alpha track counting procedures were completed by Experimental Statistics, Operations Research and Systhesis Operation. Use of the method will result in approximately a 20% reduction in alpha track counting time. The procedure will be implemented during June.

Approximately 780 pounds of salvage silver ($8,260) is being held on the Stores' receiving dock. Shipment has been delayed due to a railroad strike in San

Francisco. It is doubtful that credit for this silver will be received during FY 1957. Total silver credit to our account to date is $33,688.

Radiological Development

The binary code identifying week and year on dosimeter film proved successful. In addition to reducing film identification to a single X-ray exposure, savings of about 30 man-hours per week were noted.

Approval was received for the off-site publication of the plastic badge development report. The "Nucleonics" Journal has indicated interest in publication of the report.

An article for off-site publication covering the broad scope of electronic data processing of exposure records was completed.

The first quarterly report listing all those persons having received in excess of one rad beta plus gamma exposure for the first quarter of 1957 was completed by the Data Processing Operation. This report was produced by the Report Generator Routine recently developed by that Operation.

Samples of 6 inch hood gloves were received and routed to consumer components for evaluation. Consumer components indicated that while the hand and wrist sizes were not ideal, the glove would be accepted if necessary. The glove manufacturer reported that further changes in the glove design were not feasible. An AEC representative was requested to contact other sites regarding the hood glove problem.

Information from the Chemical Processing Department indicates the potential availability of universal unlined rubber overshoes. Investigation was initiated.

An investigation of new and modified fresh air line adapters for filtered air units was initiated. This action was undertaken for reasons of economy and as an assurance of a continued supply of fresh air conversions in event the present units become unavailable.

Several synthetic hood glove materials are under investigation as a possible solution to the use of hood gloves in certain destructive environments.

The annular sources for calibrating the standard alpha chambers were obtained. The counting efficiency of the standard chamber is 8-9% lower for an annular source as compared to a point source. The result compares favorably with data obtained at the Chalk River location for the scintillation counter.

Requirements for a continuous air sampler with alarm system for the Radiometallurgy Building are being re-evaluated because of work planned on examining test fuel material for the P. R. R.

A study was initiated to develop correction factors for the Soup Bowl dose rate meter when used in beta field dose rate determination.

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Calibrations

Three prototype scintillation poppies were examined and found to be acceptable. The small discrepancies found will be corrected here at HAPO. The vendor was advised of the discrepancies and instructed to complete the order.

Ten Samson Alpha Meters were received from the vendor. Five units have been examined and accepted. The other five are now being examined.

Two prototype scintillation poppy probes for cart-type poppies were received and found acceptable. The vendor has been instructed to complete this order for 18 units.

Radiological Consultation

Discussions were held with the Atomic Energy Commission on the possible radiological consequences of the construction of the proposed Ringold Dam. Information was requested from the Biology Operation and from the Chemical Effluents Technology Operation on the consequences in preparation for a more detailed report to the Atomic Energy Commission.

The study of gonad dose from diagnostic radiation being carried out in cooperation with Industrial Medical was reviewed and the program accelerated by the procurement of people to do the tabulations of the diagnostic procedures. Rough estimates of the dose from each type of examination will be made by the Radiological Physics Operation in order to provide some information as soon as possible.

Radiological Disaster Studies

Computations on the effects of a reactor disaster in the plutonium recycle program were started. These results are to be included in a preliminary report on the safety of the plutonium recycle reactor. The gamma dosage rates from the contained material were calculated using the gamma spectrum for total fission products previously derived. For the release of volatile materials, it was necessary to derive the gamma spectrum from the previous calculations of the quantities available in the reactor. The deposition, cloud dose, gonad dose, and lung deposition are being derived for this specific case because of improvements in the information available on the various factors of the calculation.

Preparations were made for a talk on the consequences of a disaster in the production reactors with particular emphasis on Wahluke Slope. This talk is to be presented during the visit of Mr. Block in June.

Columbia River Studies

The fraction of the MPC for drinking water at Pasco was computed for the bone dose, GI tract dose, and gonad dose for the years 1955, 1956 and for 1957 through March. These results were obtained by extrapolation of the reactor effluent basin analyses without consideration of the supporting data now available on the analyses of isotopes in the river and the spot analyses of additional isotopes now available. The results indicated an increase in GI tract dosage in the month of December, 1956 and January, 1957 as compared to the same months a year ago. During these months the results indicated approximately 50 percent of the Hanford limit for off-plant sources as compared to about 20 percent in the same months a year ago.

1103797

Radioactivity levels of the Columbia River below Richland, Washington, for the period January, February, March 1957 were reported by letter to the Columbia River Advisory Group. Reporting by unclassified HW documents was discontinued. The radioactivity was almost three times greater this first quarter than the average for the same quarter the past three years.

C. EMPLOYEE RELATIONS

Safety

There were three medical treatment injuries for a frequency of 0.75.

Security

There were no security violations.

Suggestions

Radiation Protection personnel submitted nine suggestions during May. Three suggestions were adopted and awarded a total of $35. Savings amounted to $234.24.

Twelve suggestions were evaluated and seven remain to be evaluated.

Beneficial Moves

There was one beneficial move.

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VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
Leslie L. Fowler	May 20 thru May 24, 1957	Westinghouse Electric Arco, Idaho	Obtain information on instrumentation and to review operation and techniques of the health physics and Industrial Hygiene groups.	JW Healy AJ Stevens BG Lindberg HG Ruppert PC Jerman GM Rolph RW Meisinger DC Fleckenstein RL Junkins LJ Defferding HA Meloeny	Yes	3746-300 3706-300 200 West: 2723, 2724 202-S. 100-D Area: 1703-D 100KE Area: 105-KE 300 Area: All Buildings except 303 Area. 100-H Area: No buildings.

VISITS TO OTHER INSTALLATIONS

B. G. Lindberg	May 6 & 7, 1957	Los Alamos Scientific Laboratory, New Mexico	Attend Weapons Orientation Course	Dr. T. L. Shipman	Yes	

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REGIONAL MONITORING

The general findings are summarized in the following:

Sample Type and Location	Activity Type	Average Activity Density /uc/ml	Trend* Factor
Drinking Water and Related Materials			
Benton City Water Co. Well	alpha	1.4×10^{-8}	--
Richland Wells	alpha	$(1.1 \text{ to } 4.2) \times 10^{-9}$	--
100 Areas	beta	$(0.03 \text{ to } 3.2) \times 10^{-6}$	-2
200 Areas	beta	$(0.5 \text{ to } 1.6) \times 10^{-7}$	--
Pasco, Kennewick, McNary Dam	beta	$(<0.03 \text{ to } 2.2) \times 10^{-6}$	--
Backwash Solids - Pasco Filter Plant	beta	4.5×10^{-2} /uc/gm	--
Backwash Liquids - Pasco Filter Plant	beta	1.8×10^{-6}	-2
Anthracite, Sand Filter - Pasco Filter Plant	beta	1.1×10^{-4} /uc/gm	--
Other Waters and Related Materials			
200 West Wells	beta	$<2 \times 10^{-7}$ to 5.2×10^{-3}	-20
200 East Wells	beta	$<2 \times 10^{-7}$ to 8.9×10^{-2}	+9
Wells Near 200 Areas	beta	$<2 \times 10^{-7}$ to 7.4×10^{-7}	+2
Outlying Wells	beta	$<2 \times 10^{-7}$	--
Columbia River - Hanford Ferry	beta	1.5×10^{-5}	--
Columbia River - Below Reactors	beta	1.5×10^{-5}	--
Columbia River - Paterson to McNary	beta	6.2×10^{-7}	--
Columbia River - Mud	beta	$(2.0 \text{ to } 5.8) \times 10^{-5}$	-3
Raw Water - Operating Areas	beta	$(<0.03 \text{ to } 9.9) \times 10^{-6}$	-2
Reactor Effluent Retention Basins to River	beta	20,000 to 160,000 /uc/sec/r	+2
		$(0.7 \text{ to } 1.9) \times 10^{-2}$	--
Reactor Effluent Retention Basins to River	alpha	<0.04 /uc/sec/reactor	--
		$<5 \times 10^{-9}$	--
I-131 in Farm Wastes to River	I-131	9.8×10^{-7}	--
I-131 in Columbia River - Hanford	I-131	3.9×10^{-8}	-2

* The trend factor shows the n-fold increase (+) or decrease (-) from last month, where the values of n less than 2 will not be noted.

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Sample Type and Location	Activity Type	Average Activity Density /uc/ml	Trend* Factor
Atmospheric Pollution			
Gross Alpha Emitters	alpha	(<2 to 8) x 10^{-15}	--
Gross Dose Rate - Separations Areas	beta-gamma	0.5 to 1.5 mrad/day	-3
Gross Dose Rate - Residential Areas	beta-gamma	0.6 mrad/day	--
Active Particles - Separations Areas	beta	(0.5 to 1.3) x 10^{-12}	+5
I-131 Separations Areas	I-131	(1.8 to 4.6) x 10^{-13}	--
I-131 Separations Stacks	I-131	0.6 curie/day	-2
Ruthenium - Separations Stacks	Ru-103-106	<0.02 curie/day	--
Active Particles - Wash., Idaho, Ore., Mont.	--	0.015 to 0.120 ptle/m^3	+2
Active Particles - Project	--	0.007 to 0.085 ptle/m^3	+2
Vegetation			
Environs of Separations Areas	I-131	(<0.6 to 1.4) x 10^{-5} /uc/gm	-2
Residential Areas	I-131	(<6 to 8) x 10^{-6} /uc/gm	--
Eastern Washington and Oregon	I-131	<6 x 10^{-6} /uc/gm	--
Non-Volatile Beta Emitters Wash. and Ore.	beta	(<0.09 to 5.2) x 10^{-4} /uc/gm	--
Alpha Emitters - Separations Areas	alpha	(0.05 to 2.1) x 10^{-6} /uc/gm	+2

* The trend factor shows the n-fold increase (+) or decrease (-) from last month, where the values of n less than 2 will not be noted.

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RADIATION MONITORING	Hanford Laboratories	Minor & Major Construction	Others	May	Year to Date
Special Work Permits	2099	557	257	2913	13249
Routine and Special Surveys	1415	829	180	2424	13362
Air Samples	2099	77	147	2323	11235
Skin Contamination	13	7	1	21	99

EXPOSURE RECORDS

Gamma Pencils	Pencils Processed	Paired Readings 100-280 mr	Paired Readings Over 280 mr	Lost Readings
May	242,858	17	17	8
1957 to Date	1,329,722	69	63	50

Beta-Gamma Film Badges

	Badges Processed	Readings 100-300 mrads	Readings 300-500 mrads	Readings Over 500 mrads	Lost Readings	Average Dose Per Film Packet mrad (ow)	Average Dose Per Film Packet mr(s)
May	44,359	598	46	14	58	2.04	3.40
1957 to Date	257,502	3128	117	34	344	1.83	3.08

Slow Neutron Pencils

	Pencils Processed	Paired Readings 4-12 mrem	Paired Readings Over 12 mrem	Lost Readings
May	2,556	35	11	5
1957 to Date	11,954	130	30	10

Fast Neutron Film Badges

	Badges Processed	Readings Above 50 mrem	Lost Readings
May	1064	1	3
1957 to Date	5050	1	6

Bioassay	May	1957 to Date
Plutonium: Samples Assayed	1015	6026
Results above 2.2×10^{-8} µc/sample	18	145
Fission Product: Samples Assayed	1101	6627
Results above 3.1×10^{-5} µc/sample	1	6
Uranium: Samples Assayed	486	2049

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Uranium Analyses	Following Exposure Units of 10^{-9} µc U/cc			Following Period of No Exposure Units of 10^{-9} µc U/cc		
Sample Description	Maximum	Average	Number Samples	Maximum	Average	Number Samples
Metal Preparation	20.31	2.16	134	6.31	2.73	38
Technical	7.63	2.52	28	7.50	5.10	5
*Technical	51.77	33.61	2	--	--	--
UO_3 Plant	68.86	5.61	124	28.12	4.79	99
*UO_3 Plant	121.33	12.36	37	8.51	4.29	9
Special Incidents	--	--	--	--	--	--
Random	0.57	0.44	4	--	--	--

*Samples taken prior to and after a specific job during the work week.

Tritium Analyses	May	1957 to Date
Samples Assayed	35	59
Thyroid Checks		
Checks Taken	45	199
Checks Indicating .01µc	0	1
Hand Checks		
Checks taken - alpha	61,499	274,986
- beta gamma	50,380	254,071

CALIBRATIONS	Number of Units Calibrated	
Portable Instrument Calibration	May	1957 to Date
CP Meter	1081	5368
Juno	387	1900
GM	1486	7184
Others	195	948
Total	3149	15,400
Personnel Meters		
Badge Film	2460	11,346
Pencils	9663	21,675
Others	220	1,013
Total	12,343	34,034
Miscellaneous Special Services	739	2,298
Total Number of Calibrations	16,231	51,732

R. L. Junkins, Acting Manager
RADIATION PROTECTION

1103803

LABORATORY AUXILIARIES OPERATION
MONTHLY REPORT - MAY, 1957

General

Safety performance of the Operation, as indicated by the Minor Injury Frequency Rate, approached the lower control limit. Frequency rate for May was 2.1 compared to 3.76 for April.

The absenteeism rate for all employees was down to 3.21% which is well within the expected frequency limits and about at the average expected frequency.

For the third successive month there were no security violations reported for this Operation.

Two grievances were filed during the month; one unit and one non-unit. Both were taken to Step II and the non-unit grievance, involving staffing of positions which are upgraded, was satisfactorily answered at Step II. The unit grievance involving assignment of work between HLO and IPD Radiation Monitors is pending scheduling by the Union for answer at Step II.

Facilities Engineering Operation

The economy measures exercised in the Landlord and Building Engineering field are being continued. Maintenance work is being performed at minimum safe level.

Data has been accumulated for evaluating a plan for fixed price per drawing in the Drafting function. This data will be used on a "dry run" basis for a month for further evaluation.

Approximately 800 prints were turned over by Technical Shops for sorting and filing in drafting room print file.

Information is being compiled on all Code Vessels belonging to HLO and arrangements are being made for on-site inspection of vessels.

The attached report summarizes the status of HLO project work:

The design criteria for the Radiochemistry Hot Cell has been prepared and transmitted for user and AEC signatures. The planned timing for authorization of this project is during June. Information was supplied to AEC Washington relating to the proposal. Minor scope design is continuing on this project pending authorization.

The efforts of the Project Planning and Scheduling group resulted in one Informal Request, two Project Proposals and two Plant Equipment Analysis Reports, completely developed by Facilities Engineering Operation, and two proposals prepared by CEO as follows:

CG-661	Additional Heat Generation Facilities - 189-D	$ 664,000
CG-681	Hanford Equipment in the ETR	1,200,000
CG-757	Coolant Radio Analysis Laboratory - 1706 KE	77,500
CG-758	Ceramic Fuels Development Press and Furnace	200,000
IR --	Biology Controlled Activity Water System	77,500

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The following Plant Engineering and Maintenance work was performed:

Shade screens were purchased for installation on the second floor of 3760 Building.

Construction Engineering completed preliminary studies and a cost estimate for supplemental heating in 326 and 328 Buildings and summer cooling and heating for 3760 Building.

Work is progressing on remedies to 306 Building heating system in order that it will function properly during the winter season. This work will include new fan bearings, supplemental piping insulation and an adequately sized condensate system.

Material is being ordered and installation of a Breathing Air System in 141-FS Building will start about July 1.

Installation of a Formaldehyde Exhaust System, 146-FR Building will start about July 1.

The Drafting and Design operation produced approximately 100 drawings and sketches; also, revisions were made to 126 drawings during the month. Five Draftsmen and Engineering Designers are on loan to using components in various areas. The work backlog is low but steady with approximately 35 per cent of the work now being performed on graphs, flow sheets, charts and the like.

Efforts to establish an inventory of required stainless steel items for HAPO use are continuing. Approximately 75 per cent of the requirements have been established.

Laboratories Administration and Technical Liaison

Eight additional Organization and Policy Guides were issued. A total of 153 have been issued and 36 are in draft form or ready for duplicating and distribution. Timely revisions have been issued on specific sections of ten existing guides. A partial review was made of AEC Manual chapters to determine if there were subjects requiring the revision or issuance of Organization and Policy Guides.

The following contract was processed for approval:

Contract No. DDR-4, Supplementary Contract No. 1, with the Regents of the University of California.

Requests were submitted to Transportation and Maintenance Operation for a used pickup truck for temporary assignment and a sedan as a replacement for a carry-all. The temporary assignment of the pickup truck was made. A new power wagon was assigned to Chemical Effluents Technology Operation releasing a jeep to Radiation Monitoring Operation for replacement of an existing jeep. Other assignments were handled including emergency maintenance and a listing of contaminated vehicles requested by Transportation and Maintenance Operation.

There were no new requests for service under the Assistance to Hanford and KAPL Program. The letter to the Hanford Operations Office was written requesting approval for the Assistance to Hanford Program for FY-1958.

J. L. Michaelson, Consultant - Engineering Applications, General Engineering Laboratory, visited the Hanford Laboratories May 22, 1957, on the Assistance to Hanford Program. Arrangements were made for him to meet with those persons interested in work by the General Engineering Laboratory. D. H. Marquis, Manager - Thermal Systems Engineering, General Engineering Laboratory, accompanied Mr. Michaelson.

R. E. L. Stanford and F. J. Leitz of Atomic Power Development Associates, Inc. visited the Hanford Laboratories on May 15 and 16. The immediate purpose of their visit was to consider the prospect of the Hanford Laboratories investigating some aspects of the use of molten plutonium as fuel for a fast breeder reactor. The Laboratories has some of the very specialized equipment as well as other general purpose equipment that would be required for the investigation.

Technical Shops Operation

Total productive time for the month was 13,305 hours. The total shop work backlog is 19,535 hours of which 50% is scheduled to be completed by July 1. Overtime worked during the month was 2.2% (391 hours) of the total available hours.

Distribution of time was as follows:

	Man Hours	% of Total
Fuels Preparation Department	2849	21.5
Irradiation Processing Department	2790	20.9
Chemical Processing Department	2037	15.4
Hanford Laboratories Operation	5131	38.5
Construction Engineering Operation	205	1.5
Miscellaneous	293	2.2

Customer demands for service remained firm in all components of the Operation. Emergency fabrication service on an overtime basis was provided in support of the Whitney Project and for a special request emanating from the A.E.C. A comfortable backlog exists in all components of the Operation.

The Operation participated in the "Family - Open House Day" held on June 1st. A display of typical work performed by the Operation was set up in 328 Building and received favorable comment.

Safety and security performance was considered normal with no serious violations. No grievances were received and employee morale is believed to be high.

Technical Information Operation

The inventory of Files' holdings is proceeding. During the month 33,964 copies of documents were inventoried. This included 4.970 copies of HW "T" and "L" notebooks, 4,605 copies of HDC's, 24,389 copies of S-series documents. At month's end, inventory listings for the remainder of Files' holdings were being run by Data Processing. It is estimated that this last phase of Files' inventory will be completed by July 1.

1103806

An inventory of Files' documents in the Records Center was begun during the month. In accordance with arrangements agreed upon at the time the Records Center assumed responsibility for retired classified documents, a Files inventory clerk spent part of the month assisting with the inventory at the Records Center. Copies inventoried totaled 5,678.

During the month of May, 50 documents were removed from the list of "Uncaccounted For Documents" at HAPO. Some of these were declassified, but the majority were proven to have been destroyed. This reduces HAPO outstanding documents from 209 to 161.

The Special Assignment clerks have processed all HAPO documents returned from the Yellow File in Schenectady. Total documents processed is 31,974. Time is now being spent (1) processing 50 miscellaneous documents which were part of Yellow Files but had not been previously set up in HAPO's accountability records, and (2) posting file record cards of 280 HAPO documents destroyed by Yellow File. It appears that this miscellaneous work will be finished by May 31, thus completing the special assignment.

A number of forms and procedures received attention during the month:

1. The details of the Reserve Desk were studied in an effort to streamline procedures and procedural changes were made resulting in work simplification.

2. A suggestion presented by a former Classified Files employee will improve our service to the customer who wants a document not controlled by Files. Formerly the requestor was asked to contact the author of the document. Under the new procedure, Files will send a note to the author asking him to forward a copy to the requestor. A form for this purpose is being prepared.

3. Revision pages of non-classified manuals will be mailed to the holders, rather than having files' clerks travel to the field to make the changes for the chargees.

The Hanford Operations Office has requested that all reports containing information on any CAD program (e.g. Project Bluenose, Project Crave) receive special handling. Each report will bear a special marking and its circulation will be limited on a "need to know basis." A review of the literature for these sensitive reports is approximately 80% complete.

All sections of the Hanford Classification Guide have been typed on duplimats. Work was begun on compiling the Subject Index and the target date for completion is June 7.

Memoranda outlining instructions for classifying the IPD, CPD, FPD and HLO Operating Cost Reports as Confidential - Restricted Data were distributed. These reports have been handled as Unclassified for several years. Because the basis for the instructions was not clear, and classifying these reports introduces certain delays in supplying the information to HOO, a meeting was arranged with the HOO Finance Director, HOO Classification Officer, and representatives from the Financial Operation of each HAPO component concerned. As a result of the meeting, it was determined that HLO reports, due to the work being research and

development, would remain unclassified. No other modifications to the instructions were obtained.

Work Load Statistics

	April	May
Documents routed and discharged	34,390	23,558
Documents issued	9,727	10,120
Documents destroyed	6,673	4,618
Reports abstracted	225	261
Formal R & D reports issued	6	18
Document classification changes	644	549
Books circulated	3,173	2,506
Periodicals circulated	14,193	11,204
Volumes added to the collection	441	248

Radiographic Testing Operation

A major portion of the work of the Radiographic Testing Operation this month was field tests. A total of 687 tests was made. Of the total number, 496 tests were radiographic exposures (including x-ray and gamma-ray exposures), and the remaining 191 tests were supplementary tests. The supplementary tests included ultrasonic, eddy current, and magnetic particle tests. Work was done for 17 different organizational components encompassing all of the manufacturing departments and each of the supporting operations. Reports issued detailing test findings with conclusions and recommended action totaled 18. The Radiographic Testing Operation was consulted on 18 different occasions for advice and information regarding general testing theory and applications for other than the jobs tabulated in Part II.

The fabrication work on the L-cell package for Purex has been stepped up. The shops are now contemplating completion of this work by July 1. A great deal of stainless steel pipe welding and radiographic examination of these welds is involved. By close coordination with the shops it has been possible to break this complicated assembly down into small components which permit ready access. The other large process vessel job, the Redox Slug Dissolver, is proceeding according to schedule. Some difficulties were encountered in the welding of this vessel and a certain amount of repair work will be necessary. The major amount of work done this month on this vessel was continued x-raying of 3/4 inch thick stainless steel plate.

Following up on last month's work on aluminum cans, further tests were made in an attempt to find natural defective cans for use in correlating eddy current test indications. An interesting series involved in this test were cans deliberately made from ultrasonically poor material. The can vendor selected out-of-tolerance ingots, bar stock, and can blanks from which to fabricate the test series. However, no significant difficulties were found in the cans as fabricated. Eddy current tests will be made on these same cans to see if there is any other evidence of discontinuities.

In the Zr process tube program two more 50-foot long KER size Zr process tubes were evaluated. Using existing equipment and facilities, the tests included 100% x-ray examination (single wall), 100% dye penetrant (outside surface),

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100% eddy current (internal probe), partial boroscope examination, visual, and dimensional checks. Of the two tubes examined, no indications of discontinuities were found in one length. The tube did have an extensive lap extending for about 1-1/2 feet on both walls at one section. Work is being done to add ultrasonic scanning using contact methods until immersed testing equipment is procured. Availability of the contact equipment will allow manual scanning of the tubes for internal flaws and also permit checking of wall thickness variations.

The ultrasonic thickness measurements on the water piping between 190 and 105 in the 100-B Area were completed this month. Considerable difficulties were encountered in making these tests due to the apparent internal condition in the pipes. These water lines have been in service almost 15 years and scaling is apparently rather heavy. To collaborate the test findings it will be necessary to make check readings to be sure of results. Ultrasonic thickness measurements are difficult to make under these conditions. A gamma-ray backscattering device is being investigated as a more suitable instrument for these measurements.

A new program was started this month for the IPD Hot Shop in the 108-D Building. For some time difficulty has been experienced with breakage of outage tools due to defective material or treating. The tools involved include couplers, tubing splitters, and cutting and cleaning broaches. These tools are used in removing process tubes from the piles. Failure of the tool within the pile could result in costly delays in returning the pile to operation. Magnetic particle testing is being used to examine these tools. It is contemplated that this work will be on a monthly basis to screen tools as they are used. Preliminary results wherein four defective critical pieces were caught have already proved the value of this examination.

A major problem has arisen in the Redox and Purex plants due to the potential failure of buried concrete pipes. There has been some evidence of corrosion leading to leakage of the steam and process piping. Because of the inaccessibility of this piping, it is essential that the extent of the damage be determined. To date no satisfactory examination method has been devised. Preliminary tests were made by this operation in the use of eddy current testing techniques to assist in this problem. Preliminary results were favorable. Examination of these pipes is made doubly difficult in that the work must be done under SWP conditions and because of the geometry of the pipe. Two bends were built into each pipe as a radiation protection measure. The bends vary from 60° to 90°. Standards containing simulated defects have been fabricated to be used as calibrations of the eddy current test equipment.

Testing Statistics

Customer	No. of Tests	Ft. of Weld	No. of Pieces	Description
Chemical Processing Department	146	75	12	S.S. pipe and process vessel welds.
Construction Engineering Operation	72	56	18	S.S. pipe and process vessel welds.
Fuels Preparation Department	15	24	22	Al cans and cap spires.

Testing Statistics (Cont'd)

Customer	No. of Tests	Ft. of Weld	No. of Pieces	Description
Hanford Laboratories Operation	203	153	15	Zr tubing, and miscellaneous materials.
Irradiation Processing Department	251	98	278	Carbon steel pipe and welds and miscellaneous tools.
Totals	687	406	345	

Manager,
LABORATORY AUXILIARIES

JL Boyd:po

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MONTHLY PROJECT REPORT

UNCLASSIFIED — HANFORD LABORATORIES OPERATION — MAY, 1957

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT / DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED / ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED / ACTUAL	STARTING DATE DESIGN / CONST.	BENEFICIAL USE DATE	PROJECT COMP. DATE DESIGN / CONST.
General Plant Projects - FY 1956, AEC-2-23X-56-L-2		Reactor & Fuels	$ 140,000	$ 140,000* / 4-4-57	100 / 100	2 / 2	5-23-56 / 12-7-56	As Completed	9-28-56 / 5-1-58
CG-664	350°C Flow Loop - 314 Bldg.								

REMARKS: *Includes $350 transferred equipment.
Construction Operation has prepared a complete Bill of Materials and purchase of common materials is in progress. 25 orders amounting to $52,000, for engineered material and equipment, have been placed. Delivery dates range from May to December. Field fabrication of the test loop is scheduled to start in October, 1957. Construction Operation was authorized $30,000 for L.S.C. fabrication of this loop.

General Plant Projects - FY 1957, AEC-2-23-57-N-2		Radiation Protection	$ 150,000	$ 150,000 / 2-4-57	Not Schd. / 0	Not Schd. / 0	2-18-57 / 7-30-57	12-31-57	6-1-57 * / 12-31-57*
CA-658	Shielded Personnel Monitoring Station (747 Building Addition)								

REMARKS:
The U.S. Navy has not yet released the 7¼ inch flat steel plate, located at Arco, Idaho, for use in constructing the monitoring cell. Carey and Kramer, Consulting Engineers of Seattle, Washington, were selected as the A-E for design of the facility.
*Project Proposal Date.

		Reactor & Fuels	$ 135,000	$ 135,000* / 5-2-57	100 / 100	0 / 0	10-3-56 / 5-27-57	2-2-58	1-25-57 / 3-2-58
CG-680	Corrosion Testing Facilities - 314 Bldg.								

REMARKS: *Total project cost $166,000, including $31,000 transfer of capital equipmt. Directive HW-398, Rev. 1, issued by AEC 5-2-57. Bid assembly was prepared for fixed-price contractor work, submitted to AEC, and is out for bids. Bid opening date is 6-4-57. Work release was issued to Construction Operation for $12,500 for dismantling and under-floor work and is scheduled to begin week of 5-27-57. As one bid received for the stainless steel condenser was too high, Design Operation has made fabrication details and it has been submitted to West Coast fabricators for bids.

		HLO	$ 23,000	$ 23,000 / 10-4-56	100* / 100*	60 / 60	10-1-56 / 4-9-57	As Completed	11-14-56* / 8-19-57
CA-685	Alterations to Buildings 325 and 326								

REMARKS: *G.E. and A-E only.

325 Building - Partial shipment of elevator door components was received at Pasco. Construction scheduled to start 6-15-57.

326 Building - Contract completed and accepted. Contractor's bid price to make requested changes not accepted. Changes to be included in bid package for work elsewhere in the 300 Area.

1103811

MONTHLY PROJECT REPORT

MAY, 1957

UNCLASSIFIED

HANFORD LABORATORIES OPERATION

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT / DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED / ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED / ACTUAL	STARTING DATE DESIGN / CONST.	BENEFICIAL USE DATE	PROJECT COMP. DATE DESIGN / CONST.
CA-700	Geological and Hydrological Wells	Chemical Research	$ 137,000	$ 137,000 10-24-56	100 100	16* 25*	11-8-56 10-24-56	As Wells Completed	1-15-57 12-10-57
		REMARKS: U.S.G.S. Wells - Five wells completed. Drilling in progress on 299-W-22-19 and 299-W-23-4. 2422 feet of hole completed. Fixed Price Wells - All six wells of Groups 1 & 2 completed. Drilling progressing on wells (#7) 699-38-70 and (#7) 699-30-65. 1184 feet of hole completed. Wells (#2) and (#6) completed after considerable trouble with boulders. *Fixed Price Portion on							
CA-728	High Level Exposure Facility Addition - 141-H Bldg.	Biology Research	$ 26,000	$ 26,000 2-11-57	Not Schd. 50	Not Schd. 0	3-11-57 9-15-57*	12-11-57	7-15-57 * 1-11-58 *
		REMARKS: Comment prints reviewed and returned to A-E with comments. It is still hoped to award a construction contract this fiscal year. *Project Proposal Date.							
CG-729	Ventilation System Improvements-222-U Building	Chemical Research	$ 73,000	$ 73,000 3-12-57	89 100	0 0	4-23-57 1-12-58*	6-12-58	6-12-57 9-15-58
		REMARKS: Comment prints and specifications reviewed. Comment meeting and design completion expedited in hope of awarding a fixed price construction contract prior to 7-1-57. *Project Proposal Date.							
CG-733	Plutonium Metallurgy Facility Expansion	Research & Fuels	$ 295,000	$ 295,000 5-10-57	10 10	0 0	5-14-57 6-10-57	As Completed	10-1-57 6-15-58
		REMARKS: Preliminary design started 4-11-57 and was approved by AEC. Directive HW-424, Rev.1, dated 5-10-57, was received this month. Detailed design has been started. Construction Operation started decontamination and clean-up of rooms #32, 38 and 40 and Cell #5 on 5-16-57.							
CG-757	Coolant Radio-Analysis Laboratory Addition - 1706-KE	Chemical Research	$ 77,500	None to Date None to Date	To be est To be est	To be est To be est	1* 7*	12*	4* 13*
		REMARKS: Project proposal was submitted to Contract Administration, Relations & Utilities Operation for processing on 5-27-57. It will be sent to AEC for approval this month. *Months after authorization.							

1103812

DEC

MONTHLY PROJECT REPORT

MAY, 1957

UNCLASSIFIED

HANFORD LABORATORIES OPERATION

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION: AMOUNT / DATE	PROJECT PROGRESS IN PER CENT: DESIGN SCHED / DESIGN ACTUAL	PROJECT PROGRESS IN PER CENT: CONST. SCHED / CONST. ACTUAL	STARTING DATE: DESIGN / CONST.	BENEFICIAL USE DATE	PROJECT COMP. DATE: DESIGN / CONST.
	Biology Controlled Activity Water System - 100-F Area	Biology Research	$ 19,900	$ 19,900 / Pending	100 / 100	To be est / To be est	Jan.1957 / 1 mo.*	6 mo.*	4-11-57 / 6 mo.*
		REMARKS: Estimated cost reviewed in detail with Construction Operation and Estimating. Informal Request transmitted to Commission 5-21-57.							
IR-222	Aquatic Biology Raw Water System - 100-KE Area	Biology Research	$ 8,900	$ 8,900 / 4-8-57	100 / 100	23 / 25	1-2-57 / 4-20-57	10-8-57	4-30-57 / 10-8-57
		REMARKS: Excavation for tie-ins and pump pit completed. Forms set for pit and pump received from vendor.							
Equipment Not Included in Construction Projects, FY 1956		Reactor & Fuels	$ 120,000	$ 120,000 / 2-7-57	100 / 100	0 / 0	5-1-56 / 6-1-57	8-31-57	4-1-57 / 9-30-57
CG-620	Vacuum Furnace	REMARKS: A bid package for installing was prepared by CEO on 4-18 and issued by AEC on 5-10. Bids will be opened 6-4-57. W. R. Felts, Design Engineer, inspected the equipment at National Research Co. plant on 5-6. The furnace, tank, pumping equipment and controls are to be shipped on or about 5-31-57.							
Equipment Not Included in Construction Projects, FY 1957		Reactor & Fuels	$ 664,000	$ 22,400* / 11-13-56	30 / 34	To be est / To be est	12-6-56 / 15**	23**	13** / 23**
CG-661	Additional Heat Generation Facility - 189-D Bldg.	REMARKS: Project proposal, revision 1, was transmitted to the Commission and deferred at the May 23 meeting of AEC Board of Review for further study by the Operations Division. * Interim authorization for preliminary and detailed design. **Months after authorization.							
CG-660	Modifications to the Metallographic Cell - 327 Bldg.	Reactor & Fuels	$ 147,000	$ 135,000 / 3-15-57	100 / 100	0 / 0	3-27-56 / 7-1-57	12-31-57	4-1-57 / 12-31-57
		REMARKS: Low bid for the cell addition was accepted. Total project costs, although expected to exceed $135,000, will remain within the allowable overrun.							

1103813

MONTHLY PROJECT REPORT

DEL

UNCLASSIFIED — HANFORD LABORATORIES OPERATION — MAY, 1957

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION: AMOUNT / DATE	PROJECT PROGRESS IN PER CENT: DESIGN SCHED / DESIGN ACTUAL	PROJECT PROGRESS IN PER CENT: CONST. SCHED / CONST. ACTUAL	STARTING DATE: DESIGN / CONST.	BENEFICIAL USE DATE	PROJECT COMP. DATE: DESIGN / CONST.
CG-672	Monochromatic Neutron Beam Facility - 105-KE Bldg.	Physics & Instr.	$ 195,000	$ 195,000 3-7-57	100 100	0 0	5-21-56 10-1-57	6-1-58	10-1-56 5-1-58
		REMARKS: Puget Sound Navy Yard completed their patterns for casting, and casting operations started this month. Installation is awaiting delivery of procured items.							
CA-681	Hanford Equipment in the ETR	Reactor & Fuels	$1,200,000	$ 600,000 2-8-57	100 100	62** 62**	9-17-56 6-15-57***	*	5-29-57 8-15-58
		REMARKS: Revision No. 2 of the project proposal was recalled from Mr. W. E. Johnson so that changes necessitated by increased design costs could be incorporated. It is now undergoing reapproval in HLO. Increased design costs resulted from additional requirements and revisions by the operating contractor and AEC. Bids for materials costing approximately $288,000 out of total estimated $425,000 have been accepted to date. A material take-off was completed by Construction Operation on May 9, not including drawing revisions made since April. Construction Operation indicated they can supply a major portion of the stainless steel piping requirements. The acceptable bidder for the six canned rotor primary pumps is Byron-Jackson at a unit price of $20,977. Two units will be supplied in six months and the order completed in twelve months. Phillips Petroleum Co. had indicated they are not set up to receive and warehouse our materials, but this condition has been resolved and they are now receiving materials and giving us copies of their reports. A trip was made to Arco on May 16 & 17 by representatives of HLO, CEO and AEC. Design changes, material receiving and operating problems were discussed with IOO-AEC and Phillips Petroleum Company officials. * G.E. allocated $550,000 and AEC $50,000 for partial procurement and complete design. **Procurement status based on value of orders placed. ***Estimated date only.							
CG-682	High Level Examination and Cut-Off Cell - 327 Bldg.	Reactor & Fuels	$ 430,000	$ 30,500* 2-1-57	90 76	0 0	7-18-56 6- -57	Not Est.	6-26-57 Not Est.
		REMARKS: Design continuing. Design costs through 5-19-57 were $22,847. *Interim authorization for design only.							

1103814

HW-50339

DEL

MONTHLY PROJECT REPORT

UNCLASSIFIED

HANFORD LABORATORIES OPERATION

MAY, 1957

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT / DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED / ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED / ACTUAL	STARTING DATE DESIGN / CONST.	BENEFICIAL USE DATE	PROJECT COMP. DATE DESIGN / CONST.
CA-695	Radio Telemetering Network	Physics & Instr.	$ 89,000	$ 89,000 1-10-57	Not schd. 100*	0 0	2-22-57* 7-25-57	4-15-58	5-27-57* 5-15-58
		REMARKS: Design criteria and specifications completed and transmitted to HOO-AEC for negotiation of construction contracts. *Actual by G.E.							
New Construction - FY 1958		Physics & Instr.	$2,000,000	None to date None to date	To be est 0	To be est 0	None est. None est.	None est.	None est. None est.
CG-731	Critical Mass Laboratory	REMARKS: Active consideration of alternatives is under study by the Reactor Lattice Physics Operation and the Chemical Processing Department prior to preparation of a new project proposal for FY 1958 funds. /							
CA-749	High Level Radiochemistry Cell	Chemical Research	$ 800,000	None to date None to date	100* 100*	To be est 0	4-1-57 7 mo.**	19 mo.**	5-15-57* 18 mo.**
		REMARKS: A project proposal for $62,000 for preliminary design and scoping funds has been transmitted to Washington D.C. AEC for approval. The design criteria has been prepared and is being approved within HLO. Investigation of scoping work has been started. *% of design criteria completed. **After authorization.							
	Additions to the 314 Building	Reactor & Fuels	$ 50,000	None to date None to date	To be est 0	To be est 0	1 mo.* 6½ mo.*	12 mo.*	5 mo.* 12 mo.*
		REMARKS: A project proposal for authorization of $50,000 has been prepared by CEO and was submitted to HLO on 5-29 for approvals. *After authorization.							
	Expansion of the 3745-B Building	Physics & Instr.	$ 225,000	None to date None to date	To be est 0	To be est 0	1 mo.* 9 mo.*	16 mo.*	6 mo.* 16 mo.*
		REMARKS: Project proposal has been prepared by CEO. All of the HLO approvals have been obtained and will be transmitted to Mr. W. E. Johnson's office for approval the week of 6-3-57. *After authorization.							

1103815

DEL

MONTHLY PROJECT REPORT

UNCLASSIFIED

HANFORD LABORATORIES OPERATION

MAY, 1957

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT / DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED / ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED / ACTUAL	STARTING DATE DESIGN / CONST.	BENEFICIAL USE DATE	PROJECT COMP. DATE DESIGN / CONST.
	Additions to the 622 Building	Physics & Instr.	$ 85,000	* / *	* / *	* / *	* / *	*	* / *
		REMARKS: * First draft of the project proposal was received for review and modification. Schedules have not yet been established.							
	Additions to the 305-B Building	Physics & Instr.	*	* / *	* / *	* / *	* / *	*	* / *
		REMARKS: *Project proposal initiated. Cost estimates and proposed schedule have not been completed to date.							
	Alterations to Locker Room and Associated Facilities - 327 Building	Reactor & Fuels	*	* / *	* / *	* / *	* / *	*	* / *
		REMARKS: *Preliminary scoping started preparatory to initiation of a project proposal.							
CG-744	Metallurgical Development Facility	Reactor & Fuels	$3,600,000	None to date / None to date	To be est / 0	To be est / 0	3 mo.** / *	*	10 mo.** / *
		REMARKS: Project proposal for $60,000 for preliminary design and initiation of detailed design has been approved by HOO-AEC and sent to Washington D.C. AEC for approval on 5-28-57. Last month's report erroneously reported it as being sent to Washington D.C. AEC. *To be established after scoping is performed. **Detail design only.							
CG-747	Plutonium Fabrication Pilot Plant	Reactor & Fuels	$4,000,000	$ 100,000 / 4-12-57	5* / 5*	To be est / 0	4-22-57 / 12 m.a.a.	33 m.a.a.	12-1-58 / 38 m.a.a.
		REMARKS: Preliminary layout and capacity determinations for utilities were initiated. Meetings were held with representatives of two manufacturers of extrusion presses. The advisability of utilizing a negotiated contract for procurement of major equipment items is being studied. The Commission requested a site selection study and project proposal requesting total project funds be submitted to HOO-AEC by May 15 and June 1 respectively. These have been forwarded. *Preliminary design only.							

UNCLASSIFIED

1103816

HW-50339 DEL

MONTHLY PROJECT REPORT

MAY, 1957

UNCLASSIFIED

HANFORD LABORATORIES OPERATION

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT / DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED / ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED / ACTUAL	STARTING DATE DESIGN / CONST.	BENEFICIAL USE DATE	PROJECT COMP. DATE DESIGN / CONST.
CG-758	Ceramic Fuels Development Press and Furnace Additions	Reactor & Fuels	$200,000	None to date / None to date	To be est. / 0	To be est / 0	1 mo.* / 8 mo.*	13 mo.*	6 mo.* / 14 mo.*

REMARKS: Project proposal has been prepared and was transmitted to Contract Admin., R & D on May 23, 1957. Specifications and purchase requisitions have been prepared for the sintering furnace and 300T Press. The purchase requisition for the press has been submitted to Purchasing Operation for processing.

*After authorization.

New Construction - FY 1959 Organic Coolant Test Loop in the ETR	Reactor & Fuels	$750,000	None to date / None to date	To be est / 0	To be est / 0	* / To be est.	To be est.	* / To be est.

REMARKS: The recalled project proposal for $107,000 in design funds has not been reactivated as yet.

*Scoping and preliminary design will start 2 mo. after authorization and be completed in 4 mo. Detailed design will be started 4 mo. after authorization and be completed in 11 months.

REMARKS:

REMARKS:

REMARKS:

1103817

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BM-7300-005 (11-56) AEC-GE RICHLAND, WASH.

UNCLASSIFIED

G-15

LABORATORY AUXILIARIES
MAY, 1957

VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented & Address	Reason for Visit	H.W. Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
R.E.L. Stanford F.J. Leitz	5/15,16	APDA, Detroit	Prospect of HLO doing development work on molten plutonium.	RW Benoliel OW Wick	Access Permit	2704-Z, 200 W 328, 3760
23 "Working Engineers"	5/23,24	APDA, Detroit	Tour HAPO facilities in 300 & 100 F Areas.	RW Benoliel	Access Permit	300 Area HLO Bldgs; 100-F
Carson Ekmann	5/27	Western Pneumatic Tube Company, Kirkland, Wash.	To discuss Zr tube fabrication.	RB Socky HP Oakes DE Johnson	None	703, 700
J.L. Michaelson D.H. Marquis	5/22	General Engineering Laboratory, General Electric Company, Schenectady, N.Y.	To discuss services available to Hanford from General Engineering Laboratory.	JL Boyd, LJ Lucas RE Rostenbach, LP Bupp, VR Cooper JJ Cadwell, JM Batch KG Toyoda, OF Hill, EW Christopherson, DW Pearce, AE Smith RW Benoliel	Yes	326, 328, 3760, 300 Area

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
J.L. Boyd	5/16,17	Reactor Test Station, Arco, Idaho	Engineering Conference on ETR and Hanford test installations	Mr. Phillipson (AEC - Idaho Falls) R. Nertney - (Phillips Petroleum et. al.)	Yes

J L Boyd 6/10

Manager,
LABORATORY AUXILIARIES

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1103818

General

On May 31 the staff of the Hanford Laboratories Operation totalled 1155, including 475 exempt and 680 non-exempt employees. Of the total exempt employees there were 411 with college degrees, including 395 technical degrees as follows:

BS	MS	PhD
199	101	95

In addition there are 35 non-exempt employees with college degrees.

Distribution among the nine level 3 components is included in Table I.

Personnel Development and Communications

Engineering Personnel Register forms were mailed to 250 unregistered HLO scientists and engineers. Registration of these individuals will be effected by July 15, 1957.

Forms for the Manufacturing Services Personnel Inventory were received and distributed to managers of qualified MSPI candidates.

Approximately 40 managers and individual contributors were selected to participate directly in the training of AEC Radiological Physics Fellows during the coming summer. Of this number, approximately 32 will present a series of lectures on technical subjects.

Detailed schedules of activities and information brochures for the AEC Radiological Physics Fellowship Program were prepared and distributed to course contributors and participants.

Eighty exempt employees attended a two-hour course on the subject of the Prime Contract, eight attended the course "Data Processing", and ten are participating in the human relations course "Understanding People".

At month's end twenty-two Technical Graduates and seventeen Technician Trainees were assigned within HLO.

Thirteen employees participated in the Area Tour for Women.

Communications activities during the month were primarily concerned with conducted tours for press photographers and newsmen on May 8, 9 and 13, preparation for the first 300 Area Family Open House and the production and distribution of the first issue of the monthly Hanford Laboratories News.

Twenty technical articles, papers, and speeches were processed for publication during the month.

Personnel Practices

Suggestions - At the May meeting of the Suggestion Board 19 suggestions were reviewed and 15 were adopted. Ten represented tangible savings of $5,087.80 and 5 represented intangible savings. A total of $635.00 was granted in awards.

During May 29 suggestions were received from HLO employees, representing 4.3 suggestions submitted per 100 eligible employees. This compares with 4.8 and 3 respectively during April and March.

Awards totalling $2840 have been paid to Hanford Laboratories employees since January 1, 1957.

Retirements - Two HLO employees, W. W. Mills and M. H. Gooden were processed for retirement to be effective June 1, 1957.

Insurance - Certificates for the new Comprehensive Insurance Plan which was effective November 1, 1955 were distributed to all HLO employees during May.

Benefit Plans - Hanford Laboratories participation in the Employee Benefit Plans as of the end of May is listed below:

	May	April
Pension Plan	97.9	97.8
Insurance Plan	99.5	99.5
Savings and Stock Bonus Plan	60.2	59.6
Savings Plan	8.7	8.7

Selective Service - The military status of HLO employees is shown in the following table.

STATUS		Non-Technical	Technical	Non-Technical A-1	*Critical	Total
Reservists	Standby	11	23	0	1	35
	Ready	18	18	5	2	43
	Total	29	41	5	3	78
Non-Veterans		31	35	21	38	125
TOTAL		60	76	26	41	203

*Critical refers to those employees for whom deferments are currently being requested.

1103820

Placement and Records

Non-Exempt Transfers - Three HLO employees were transferred to other HAPO components. These included one Machinist Trainee to IPD, one general clerk to FPD and one general clerk to CPD. One secretary transferred to HLO from Construction Engineering and one Instrument Maker from IPD.

Attendance Recognition - Eleven attendance recognition awards were issued during the month, including two four-year, three two-year, one-five year, and five one-year awards.

Service Recognition - There were twenty-one five-year and five ten-year pins issued during May.

Personnel status changes of exempt and non-exempt employees and transfer activities are summarized statistically in tables I, II and III.

Technical Personnel Placement

PhD Recruiting - Ten PhD candidates visited Richland for HLO interviews. There were 11 offers extended by HLO during May and 2 acceptances and 1 rejection received during the month. Since September 1, 1956 there have been 48 PhD offers extended, 8 acceptances received and 17 offers continue open. In addition 5 acceptances have been received to offers extended prior to that date bringing the total HLO PhD acceptances received during the current year to 13.

HAPO PhD statistics are summarized in Table III.

BS/MS Experienced Recruiting - Seven experienced candidates visited Richland for intervies during May. HLO extended two offers, both remain open. One acceptance was received from a candidate considered earlier during the year. To date 25 offers have been extended by HLO and have resulted in 12 acceptances with 5 offers remaining open.

Technical Graduate Program - Through May 31, 1957 Relations and Utilities have extended 267 offers and received 77 acceptances for the Technical Graduate Program. The quality of graduates accepting HAPO offers appears to be very good and there is a heavy emphasis on engineering candidates.

1103821

Summer Program - HLO will employ 7 professors, 2 graduate students, 10 juniors and 3 High School Teachers on a temporary basis during the coming summer.

Exempt transfer statistics are summarized in Table IV.

Union Relations

The HAMTC has submitted a request for another meeting regarding the negotiations with the Regional Monitors.

Another meeting has been scheduled for early in June with the HAMTC to discuss the Wonacott arbitration case involving jurisdiction of Radiation Monitors.

The National Labor Relations Board's hearing on IPD's 1706-KER unfair labor practice charge has been scheduled for June 4, 1957.

Three grievances were received during the month. One was a non-unit grievance and was settled satisfactorily at Step II. The second grievance was received from a Radiation Monitor pertaining to safety and contamination and was settled satisfactorily at Step I. The third grievance was also submitted by a Radiation Monitor claiming misassignment of work and the Step I answer was unsatisfactory. This latter case is pending Step II discussions.

Grievances processed by HLO since 9/1/56 now total 22, including 2 non-unit grievances. The status of these grievances is summarized in Table V.

Salary and Wage Administration

All appraisals for HLO exempt employees for the current year have now been completed and are on file with Salary Administration.

Seven exempt position audit interviews were conducted during the month.

Approval by the local AEC was received to revise the design and draftsman classifications in order to bring the pay rates of the draftsman classification up to scale.

During the month audits of 45 non-exempt positions were made. The status of these audits is as follows:

	No. of Jobs	Audits Performed
Secretarial	60	25
Clerical	126	78
Semi-technical	120	55
Manual	26	9

1103822

As a result of the audits 8 job descriptions were revised, re-evaluated and properly classified.

Health and Safety

On May 22 Hanford Laboratories personnel qualified for the first Safety Council Award as a result of completing 264 days without a disabling injury.

During May Laboratories personnel worked a total of 197,206 hours with no disabling injuries. Since September 1, 1956 a total of 1,704,304 hours have been completed with no disabling injuries.

There were 28 medical treatment injuries this month with a frequency of 1.42 as compared to 2.02 for the previous month. The frequency for the year to date is 1.73.

Three of the reported injuries were minor exposures to oxides of nitrogen gas resulting from explosion of a reaction vessel in A Cell of 321 Building on May 31. These employees did not suffer any serious or continuing effects from this exposure. The explosion occurred during addition of nitric acid to turnings and fines of enriched uranium metal. Estimated damage was slightly in excess of $10,000 including loss of uranium and cost of repairs.

There were two other unusual incidents during May, one involved a barrel of scrap uranium which burned spontaneously and resulted in a loss of $235, and one involving the breakage of the element in a Hypersonic Transducer which caused a fire resulting in very minor loss.

There were three security violations reported during the month brining the total for the year to 43.

W. A. Burns for

T. G. Marshall:vf

1103823

VISITS TO HANFORD WORKS

Name	Dates of Visit	Company or organization represented & address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
M.J. D'Arcangelo	5/22/57	General Electric Co. New York, New York	Consultations re. Attitude & Morale Measurements	T.G. Marshall A.P. Hudspeth A.H. Brandt D.C. Fleckenstein H. A. Paulsen	No	W-10 Bldg. 1100 Area
J. T. Fontaine	5/22/57	General Electric Co. New York, New York	Consultations re; Attitude & Morale Measurements	T.G. Marshall A. P. Hudspeth A. H. Brandt D.C. Fleckenstein H. A. Paulsen	No	W-10 Bldg. 1100 Area
L. L. Fowler	5/23/57	Westinghouse Co. Arco, Idaho	Discuss training Radiation Protection	D.C. Fleckenstein	No	3702 Bldg. 300 Area
Wells Moulton Geo. Austin J. S. Walton	5/7/57 " "	Univ. Washington) Washington State) Oregon State)	Meeting of ASEE Selection Committee	T. G. Marshall W. A. Burns C. A. Rorhmann D. S. Roberts V. R. Cooper	No	None

NO VISITS WERE CONDUCTED TO OTHER SITES.

1103824

TABLE III. EMPLOYMENT - TECHNICAL PERSONNEL STATUS

I. Employment

Non-Exempt Employment Status	April	May
Requisitions		
At end of month	26	17
Cancelled	14	8
Received during month	9	9
Filled during month	9	10
Candidates considered		
Total Applications	6	2
Total Transfer Request from other at HAPO	5	9
Total interviewed	0	0

Non-Exempt Transfer Requests	April	May
Transfer Cases		
Active Cases at end of Month	47	51
Cancelled	2	2
New during month	12	10
Transfers effected	6	4
Planned Transfers		
Effective during month	2	3

II. Technical Personnel Placement

Ph.D. Recruiting

		VISITS TO RICHLAND				OFFERS			On
	Cases Considered	Extended	Visited	To Visit	Open Invite.	* Extended	* Accepted	* Open	The Roll
Engineering:									
Chemical	63	32	10	6	4	6	1	3	-
Electrical	20	7	-	5	-	1	-	1	-
Mechanical	24	16	3	4	5	4	2	1	-
Metallurgical	41	24	7	3	10	4	-	2	-
Other	2	-	-	-	-	-	-	-	-
Science:									
Chemistry	233	81	28	14	8	21	1	8	1
Physics	235	110	24	28	21	17	4	4	2
Math-Stat.	47	13	2	3	1	-	-	-	-
Other	43	8	7	1	-	6	4	-	2
DVM	4	-	-	-	-	2	2	-	1
TOTAL	712	291	81	64	49	61	14	19	6

*Offer totals include 12 carry-overs from the 1955-56 season with 3 acceptances not on the rolls as of 9/1/56 and 7 open offers at that time.

BS/MS Experienced Recruiting

		VISITS TO RICHLAND				OFFERS			On
	Cases Considered	Extended	Visited	To Visit	Open Invite.	* Extended	* Accepted	* Open	The Roll
Engineering:									
Chemical	15	7	3	-	-	1	-	1	-
Electrical	24	13	6	1	-	3	2	-	1
Mechanical	33	23	15	1	2	5	3	-	2
Industrial	7	4	3	-	-	3	2	-	1
Metallurgical	20	13	7	-	2	4	3	1	1
Ceramic	4	3	3	-	-	4	1	1	1
Other	16	5	2	-	-	-	-	-	-
Science:									
Chemistry	26	6	2	-	-	2	-	2	-
Physics	12	5	3	-	-	2	1	-	1
Math-Stat.	5	3	3	-	-	3	2	-	2
Other	39	2	2	-	-	-	-	-	-
TOTAL	201	84	49	2	4	27	14	5	9

*Offer totals include 2 carry-overs from the 1955-56 season which were acceptances not on the roll as of 9/1/56.

1103825

IV. Exempt Transfer Cases

		Since 9/1/56		May	April
Total Cases (Includes those initiated prior to 9/1/56)					
Initiated by employee	44				
Initiated by management*	17				
Total		61			
Active Cases at beginning of month:				19	19
New cases:					
Initiated by employee			1		
Initiated by management*			0		
Total				1	1
Cases reactivated				1	0
Total				21	20
Cases closed:					
Transfers: Within HLO	4		0		
Within HAPO	2		0		
Other G.E.	11		1		
Withdrawn	17		0		
Terminated	8		1		
Total		42		2	1
Total active Cases at end of month:				19	19

*Includes ROF's, transfers proposed by employee's management, and requests from other G.E. departments.

V. Union Relations

Grievances Processed - September 1, 1956 to date

Total processed 22 (includes 2 non-unit grievances)

Step I

Pending Step I Answer	0
Answered Satisfactorily*	11
Pending time limit	1

Step II

Pending Step II Discussion	0
Pending Step II Answer	0
Answered	
Satisfactorily**	10
Unsatisfactorily	0
Pending time limit	0

* Step I grievances which Council indicated a desire to discuss at Step II not scheduled for discussion within three months are considered settled at Step II.

** Step II grievances in which the Council formally applied for arbitration but for which no further action is taken within three months are considered settled at Step II.

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FINANCIAL OPERATION MONTHLY REPORT
May, 1957

Compiled by Members of the
FINANCIAL OPERATION
HANFORD LABORATORIES OPERATION

Personnel

There were no personnel changes in the Financial Operation during May.

Activities

General Accounting Operation

Several adjustments were made in the allocation of funds to Level 3 HLO components for attendance at meetings of professional and trade societies in order to allow maximum utilization of such funds for FY 1957. Current plans indicate that the remaining amount will be exhausted by June 30.

The amount of time required for reproduction of 3 x 5 cards by 300 Area Duplicating has been increased because of union demands that a certain process be discontined. The maximum number of days required for reproduction of March cards was four days, while the comparable figure for April cards was eight days.

A significant increase in the average daily variation from travel and living expense of Hanford Laboratories Operation was noted during the month of April compared to prior months. A comparison was made of the trend in such expenditures by HLO during the current fiscal year with other HAPO components. In general, it was noted that most of the other components reflected the same trend.

During the month AEC reduced equipment funds available to HAPO by $615,000. HLO's portion of this reduction amounted to $343,000. A change in control of equipment funds was made during the month. These funds will be controlled at the purchase requisition stage for the balance of the fiscal year in order to avoid a hiatus in the processing of appropriations requests.

HLO has been advised by Contract Administration that AEC plans, effective with FY 1958, to change their control on equipment from an obligational ceiling to a cost ceiling. This would mean that equipment and projects committed in FY 1957 but which do not become cost until FY 1958 would be applied against the FY 1958 cost ceiling. The effect of this proposed change is difficult to evaluate as it is not known to what extent AEC will consider the obligational ceilings at the close of FY 1957 in establishing cost ceilings for FY 1958. Also the flexibility of transfer of funds from underruns in other budget categories to the equipment category is not known.

On May 31, HLO-Chemical Development Operation, 321 Building experienced a dissolver explosion involving enriched uranium chips. Resultant loss of SS Material approximates $8,000 with possibility of recovery of perhaps one half of this amount.

Cost Accounting Operation

Reorganization of the Cost Accounting Operation was completed during May with the exception of acquiring the remaining personnel needed consisting of one exempt person and one business graduate. The significant factor in the reorganization is a change from functional responsibilities of individual exempt positions to responsibilities on the basis of the components being serviced.

A meeting was attended on May 28, 1957 with representatives of UCRL, HOO-AEC and Hanford Laboratories personnel concerning financial matters of Hanford assistance to UCRL. Matters discussed were as follows:

(1) UCRL intends to finance the program in FY 1958 at a level of expenditures of $550,000 for operating costs and $100,000 for capital equipment. UCRL representatives assured us that we would receive purchase orders prior to July 1, 1957 in amounts of $135,000 for operating costs and $35,000 for capital equipment to cover the first few months' expenditures.

(2) UCRL representatives agreed that the FY 1957 purchase order for capital equipment in the amount of $280,000 would remain open after June 30, 1957 to cover General Electric commitments on that date.

Financial Operation had been requested to comply with an AEC request to classify operating cost reports as Confidential - Restricted Data on the basis that all HAPO cost reports when combined with other unclassified data permit a good estimate of Hanford production. This was rescinded at a later date for Hanford Laboratories as a result of a meeting attended by representatives of HLO, the product departments and HOO-AEC. Had this not been rescinded a delay in issuance of cost reports and a general reduction in the usefulness of the reports would have resulted.

The Hanford Laboratories budget for FY 1958, as previously submitted to Contract Administration, has been adjusted in accordance with changes imposed by the General Manager - HAPO. These adjustments were deemed necessary so that the General Electric budget would conform with the budget submitted by Washington AEC to Congress. Changes incorporated in Hanford Laboratories budget are as follows:

Operating Costs:

Reduction in 2000 Program Research and Development	$820,000
Reduction in expenditures applicable to production	350,000
Reduction in 6000 Program Research and Development	100,000
Increase in 4000 Program Research and Development	832,000
Net Reduction in Operating Costs	$438,000

Capital Equipment:

Increase in 4000 Program	$127,000

Budgeted Personnel: (at quarter ending dates)

	6-30-57	9-30-57	12-31-57	3-31-58	6-30-58
*Reductions	3	23	31	45	40
Revised Totals	1 172	1 168	1 167	1 165	1 168

*Includes reductions for recent changes in Assistance to UCRL.

Personnel Accounting Operation

Insurance certificates were delivered to employees who have elected to participate in the Insurance Plan. These certificates cover the revised Insurance Plan with comprehensive medical expense benefits effective November 1, 1955.

Insurance and Pension authorization cards were microfilmed during the month in line with the record keeping program conducted at HAPO.

All data required to calculate the weekly payroll and maintain personnel information was transferred to magnetic tape effective May 7, 1957.

As Memorial Day, May 30, 1957 was an observed holiday for HLO employees, weekly and monthly salary checks were delivered to component representatives on May 29, 1957.

Auditing

A report on the Audit of Physical Inventories was issued on May 31, 1957. The Audit of Payroll was in progress and is scheduled for completion in June.

Measurements

Preliminary plans have been made for a July 1957 report covering progress made towards the goals established for FY 1957. A report concerning a new unit cost for Personnel Meters was completed.

Office Procedures

During the month, the systems study of property accounting procedures in General Accounting continued with a complete analysis of EDPM procedures used in plant and equipment inventory control and reporting.

Payroll Statistics

Changes during month	Total	Exempt	Non-Exempt
Employees on payroll at beginning of month	1 167	477	690
Additions and transfers in	8	2	6
Removals and transfers out	- (20)	(4)	(16)
Employees on payroll at end of month	1 155	475	680

Gross payroll paid	May	April
Exempt	$345 980	$345 131
Non-Exempt (5 weeks in May)	342 235	268 212
	$688 215	$613 343

Overtime payments	May	April
Exempt	$ 632	$2 288
Non-Exempt (5 weeks in May)	5 666	3 701
	$6 298	$5 989

Insurance claims paid	May Number	May Amount	April Number	April Amount
Employee				
Life Insurance	-0-	-0-	-0-	-0-
Weekly sickness and accident	15	$ 919	21	$ 844
Comprehensive medical	38	4 194	67	5 775
Dependents				
Comprehensive medical	43	5 732	133	11 114
	96	$10 845	221	$17 733

Good Neighbor Fund	May	April
Number participating	781	797
Percent participating	67.6%	68.3%

Other Statistics

Cash advances and travel expense		May		April
Advances outstanding at beginning		$11 851		$15 384
Advances issued-by checks	35	4 663	35	5 227
-by cash	27	3 430	54	5 538
-air travel orders		7 259		7 653
		27 203		33 802
Less:				
Expense vouchers processed				
Travel expense accounts	58	12 349	63	15 591
Other (movement of household goods, conference expense, etc.)	24	1 098	26	1 321
Refund of advances	50	5 187	63	5 176
Billing to and from HAPO components		396		(137)
		19 030		21 951
Advances outstanding at close	29	$ 8 173	37	$11 851

Project Proposals and Appropriation Requests

	Project Proposals	Appropriation Requests
On hand beginning of month		--
Received		18
	--	18
Recommended for approval		16
Recommend for rewrite		1
Returned - lack of funds		1
Total	--	18
On hand at close of month	--	1
Appropriation requests receiving final Approval during month		
Number	29	
Amount	$210 104	

W. Sale/bk
June 10, 1957

INVENTIONS OR DISCOVERIES

All persons engaged in work that might reasonably be expected to result in inventions or discoveries advise that, to the best of their knowledge and belief, no inventions or discoveries were made in the course of their work during the period covered by this report except as listed below. Such persons further advise that, for the period therein covered by this report, notebook records, if any, kept in the course of their work have been examined for possible inventions or discoveries.

INVENTOR	TITLE OF INVENTION OR DISCOVERY
G. E. Driver	Variable Frequency Oscillators
T. K. Bierlein	Etching Apparatus and Technique
W. L. Wyman	Apparatus for Fusion Welding in a High Vacuum System
T. R. Cartmell	A High Sensitivity Humidity Meter
R. H. Moore	A Method for Separation of Americium from Molten Plutonium Metal

F. W. Albaugh

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